

## Bibliometric Study and Mapping of Research Output and Collaborations on Tropical Medicine in Nigeria

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### ABSTRACT

**Objective:** Tropical medicine deals with endemic diseases, infections, and critical health issues in tropical countries. Research on tropical medicine is expected to have priority in those countries and therefore, it is necessary to monitor the relevant research. Therefore, this research aims to study the trends of research output on tropical medicine in Nigeria and map the country's collaboration in this field.

**Materials and Methods:** Based on the publications indexed in the Web of Science Core Collection, a query was performed to find Nigeria's research output on tropical medicine during 1983-2018. In total, 2,617 records were obtained and then analyzed to find the research growth and collaboration patterns in this period.

**Results:** Divided by document types, original articles are the most frequently published research output on tropical medicine. The trends of publication show high attention to tropical medicine between 2009 and 2013. Among different subcategories of tropical medicine, public environmental and occupational health is the most popular category for Nigerian authors (1,489 items). The analysis of collaboration patterns shows that articles with two authors have the highest number. The University of Ibadan is the most productive institute and most of the research has been financially supported by the Federal Government of Nigeria. The USA and the UK are the main international collaborators for Nigerian tropical medicine scientists.

**Conclusion:** The findings of the present study revealed that public health, including environmental and occupational health, is the main category for Nigerian scientists who conducted the research on tropical medicine. This is in line with current health problems in African countries which are mostly related to public health issues.

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## Introduction

Tropical medicine is an interdisciplinary field of medicine that deals with health issues, which occur uniquely and are widespread and difficult to control in tropical and subtropical regions. Sir Patrick Manson is recognized as the father of tropical medicine and he is the founder of the London School of Tropical Medicine (Manson-Bahr, 1962). His work on discovering vectors as the mode of transmission of tropical diseases was critical in the founding of tropical medicine and the current understanding of tropical medicine. Most infections they deal with are endemic to the tropics few of the most well-known are malaria, HIV/AIDS, and tuberculosis, and the 13 neglected tropical diseases (Arnold, 1996). Of all African nations, Nigeria has the highest number of people having problems with tropical medicine. With the right political will, the country has sufficient resources to expand its current investments for the important work on tropical medicine research (De Cock et al., 1995).

Bibliometric analysis is a method used to analyze research literature using mathematical and statistical methods. It allows for quantitative measurement of literature, as well as shows the relationships and clusters of authors, countries, organizations, and trends of publications (Broadus, 1987). It is a method used to visually present the knowledge structure employing scientific measurement and graphic plotting, through the use of databases and visualization tools VoSviewer, Pajek, and CiteSpace (van Eck & Waltman, 2009). That provides a way of revealing the core structure of scientific knowledge. Assessing these research trends can afford the researchers to identify research gaps that future studies can be exploited. It is against this background that the researcher intends to make a study on bibliometric analysis and knowledge mapping on tropical medicine publication outputs in Nigeria indexed on the WoS database to show authorships, co-authorships, collaborations between individuals, countries, funding agencies, and organizations which will show the relationship among them in tropical medicine studies from authors, institutions, agencies, organizations. What are the areas that need to be researched more on tropical medicine in Nigeria?

## Materials and Methods

### *Data Source and Research Process*

In this study, we used the Web of Science Core Collection of Clarivate Analytics. The ADVANCED SEARCH command for retrieving the documents published by Nigerian researchers concerning "tropical medicine" was as follows:

CU=Nigeria

Then, the results were refined by the “*Research Area*” and were limited to the “Tropical Medicine”. The time span was “from 1983-01-01 to 2018-12-30,” and the “*Document Type*” was all documents on tropical medicine published with Nigerian affiliations. No language restrictions were set as all publications were in English. The results retrieved from the Web of Science Core Collection were extracted in the form of “Plain text” in the form of “full record and cited references”, and in batches of 500 from the Web of Science database were downloaded (Gholampour et al., 2023). The data was extracted on June 20, 2019.

### *Analytical Tool and Method*

Visualization software can produce node-link maps that allow us to intuitively observe the publication outputs, most productive authors, co-authorship, co-citations, and other aspects of a research field. In this study, the data were imported into VoSviewer software and analyzed systematically. VoSviewer is visualization software that has the advantage of displaying cluster analysis results. The knowledge maps generated using VoSviewer are represented as nodes and links. The nodes and their labels, such as countries, organizations, authors, and co-citations, are proportional to the weight of the analysis components. The links between the nodes reflect the relationship between the components. In this study, co-authorship, co-citation, and collaboration networks were applied to construct the knowledge map of the tropical medicine research trends.

## Results

### *Distribution of tropical medicine Publications in Nigeria: 1983-2018*

Table 1 shows the statistical distribution of different publications (document types) studied in this research based on the trend of tropical medicine publications in Nigeria during 1983-2018.

**Table 1. Distribution of tropical medicine publications in Nigeria 1983-2018 based on WoS**

Years	Document Types				Total
	Articles	Notes	Proceedings Papers	Reviews	
1983	86	3	0	0	89
1984	93	6	0	1	100
1985	101	7	0	2	110
1986	88	8	0	1	97
1987	65	5	0	0	70
1988	69	8	0	1	78
1989	74	3	0	1	78
1990	84	12	0	1	97
1991	60	11	1	2	74
1992	76	9	0	0	85
1993	50	18	0	0	68
1994	32	10	2	0	44
1995	38	14	0	0	52
1996	35	0	0	0	35
1997	56	0	1	0	57

<b>1998</b>	46	0	0	0	46
<b>1999</b>	47	0	1	0	48
<b>2000</b>	51	0	2	0	53
<b>2001</b>	45	0	2	2	49
<b>2002</b>	47	0	1	1	49
<b>2003</b>	30	0	3	0	33
<b>2004</b>	47	0	0	1	48
<b>2005</b>	65	0	0	1	66
<b>2006</b>	63	0	3	2	68
<b>2007</b>	73	0	3	1	77
<b>2008</b>	69	0	0	4	73
<b>2009</b>	96	0	1	4	101
<b>2010</b>	110	0	0	2	112
<b>2011</b>	87	0	0	2	89
<b>2012</b>	77	0	0	1	78
<b>2013</b>	73	0	0	3	76
<b>2014</b>	70	0	0	3	73
<b>2015</b>	75	0	0	1	76
<b>2016</b>	89	0	0	3	92
<b>2017</b>	75	0	0	6	81
<b>2018</b>	85	0	0	10	95
	<b>2,427</b>	<b>114</b>	<b>20</b>	<b>56</b>	<b>2,617</b>

As Table 1 shows, one will notice the yearly trend of publications on tropical medicine in Nigeria based on the WoS classification these are articles, notes, proceeding papers, and reviews with each being shown based on scientific production. Articles have the maximum scientific production between the years under study from 1983-2018 with 2,427, followed by notes 114, reviews 56, and proceeding papers 20 making a total of 2,617, with the years 2010, 2009, and 2013 having the maximum and 2003, 2001, and 1998 with minimum scientific articles production this is followed by notes with a total number of 114 productions with maximum production coming in the years of 1993, 1990 and 1991 and lowest production in 1983, 1987, and 1984. Then reviews with a total of 56 scientific outputs and the maximum in the years of 2018, 2017, and 2009 the years of 1988, 1989, and 1984 recorded the minimum. Proceeding papers have the lowest scientific production in all having 20 in totals with the maximum coming between the years of 2006, 2007, and 2003 and the lowest in the years of 1999, 2002, and 2009. These data are represented in Figure 1.

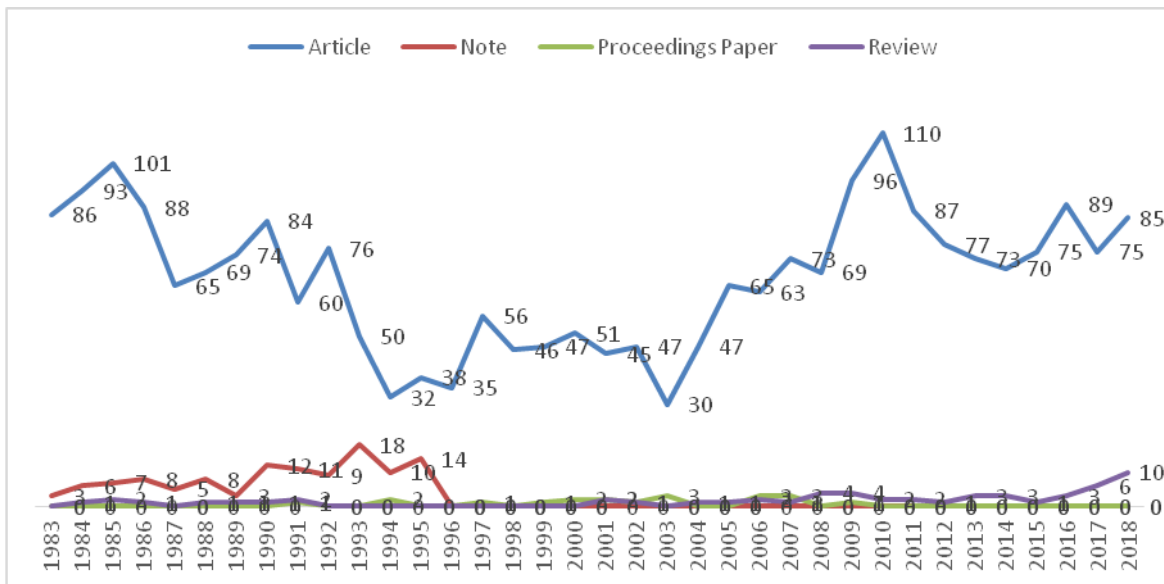


Figure 1. Trends of tropical medicine publication in Nigeria 1983-2018

### Topics covered by tropical medicine publications in Nigeria

Table 2 categories of tropical medicine in the WoS database. The table show categories of tropical medicine publications as covered in the WoS database and the distribution of scientific production based on the categories as reported in the research.

Table 2. Categorizations of tropical medicine publications in the WoS database

Subject Areas	Frequency	Percent
1 Tropical Medicine	2,617	100
2 Public Environmental Occupational Health	1,489	56.897
3 Parasitology	654	24.99
4 Pediatrics	438	16.737
5 Infectious Diseases	304	11.616
6 Veterinary Sciences	85	3.248
7 Pathology	43	1.643
8 Dermatology	38	1.452
9 Microbiology	3	0.115
10 Toxicology	2	0.076
11 Zoology	2	0.076
Total	2617	100

Table 2 indicates the tropical medicine's total research output which is 2,617 in the first row between the years 1983-2018 and it went further to show the total scientific contribution of each category that made up the total output. It indicates that public environmental occupational health

has the maximum publication of 1,489, followed by parasitology with 654 publications followed by pediatrics with 438, and infectious diseases with 304 with toxicology and zoology having a minimum of two publications each within the period under study. These data are represented in Figure 2.

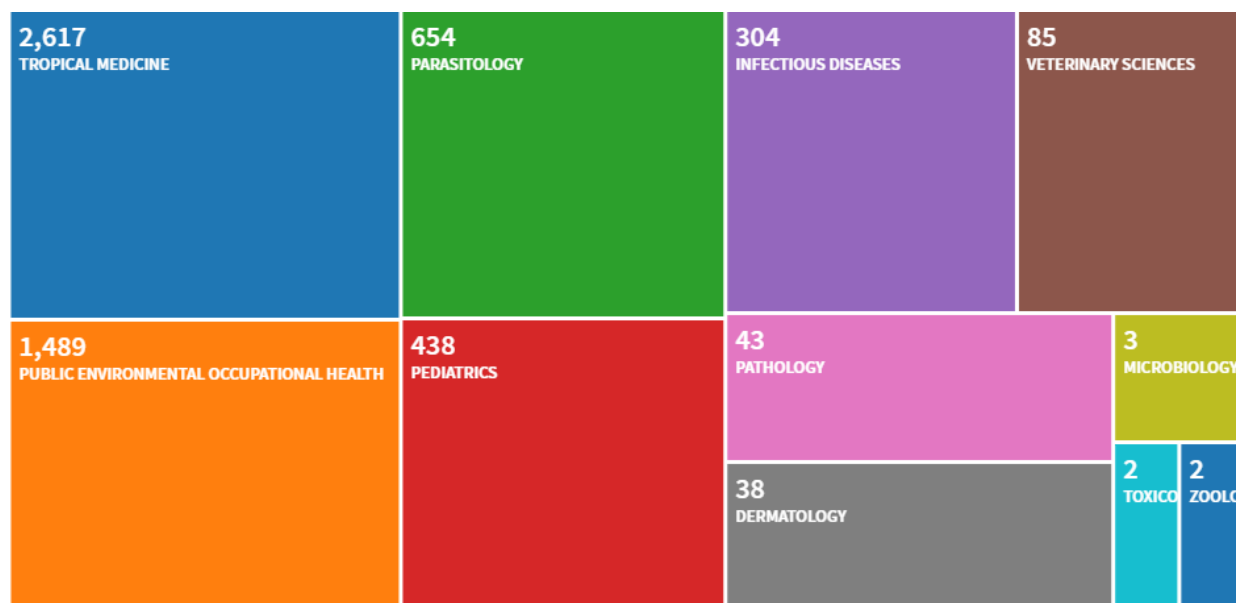


Figure 2. Distribution of tropical medicine publication in WoS database (Source: WoS database)

### *Authorship patterns on tropical medicine research publications in Nigeria*

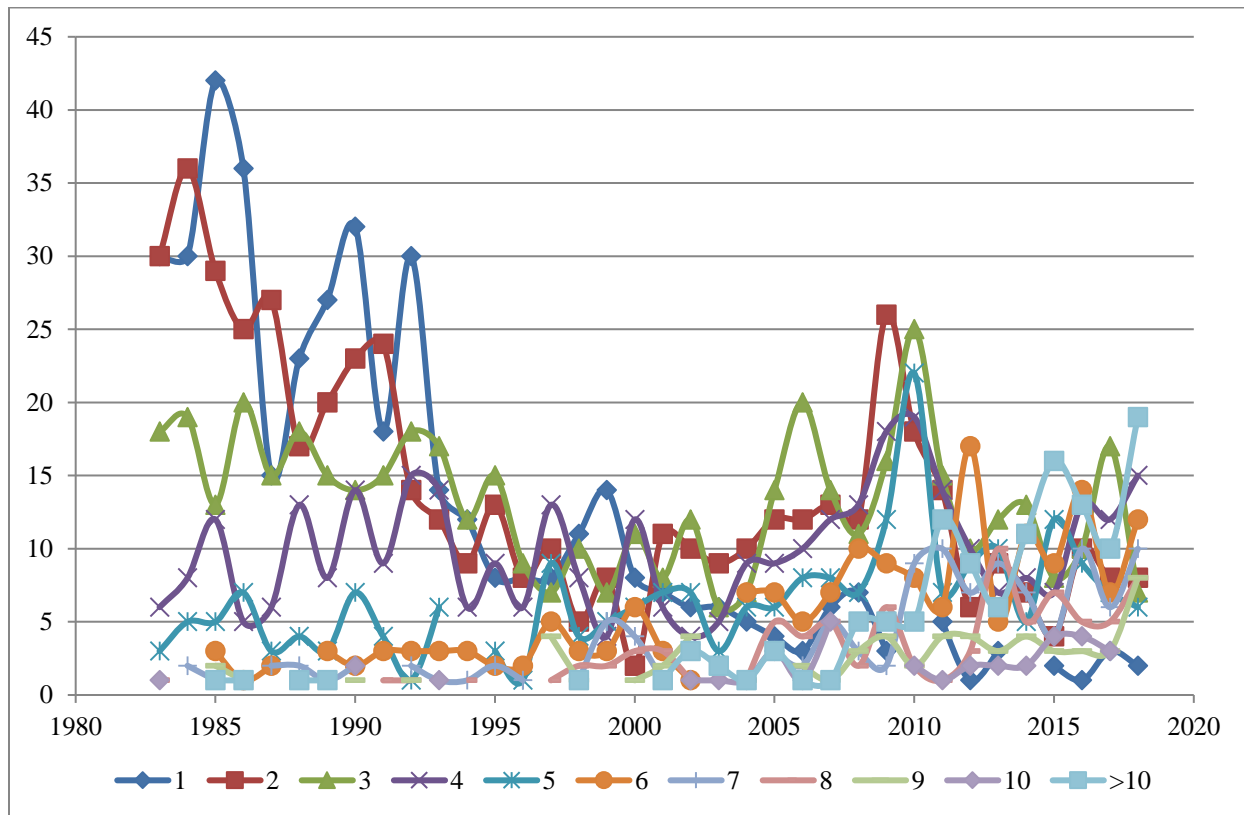
The data are tabulated to show the authorship pattern in the field of tropical medicine publication in Nigeria from 1983-2018 from one author publication to publications with 10 or more authors.

Table 3. Authorship patterns of tropical medicine publication in Nigeria from WoS database

Years	Articles publications per year based on the number of authors											Total
	1	2	3	4	5	6	7	8	9	10	>10	
1983	30	30	18	6	3	0	0	1	0	1	0	89
1984	30	36	19	8	5	0	2	0	0	0	0	100
1985	42	29	13	12	5	3	1	2	2	0	1	110
1986	36	25	20	5	7	1	0	0	1	1	1	97
1987	15	27	15	6	3	2	2	0	0	0	0	70
1988	23	17	18	13	4	0	2	-	0	0	1	78
1989	27	20	15	8	3	3	1	0	0	0	1	78
1990	32	23	14	14	7	2	2	0	1	2	0	97
1991	18	24	15	9	4	3	0	1	0	0	0	74
1992	30	14	18	15	1	3	2	1	1	0	0	85
1993	14	12	17	14	6	3	1	0	0	1	0	68
1994	12	9	12	6	0	3	1	1	0	0	0	44

<b>1995</b>	8	13	15	9	3	2	2	0	0	0	0	52
<b>1996</b>	8	8	9	6	1	2	1	0	0	0	0	35
<b>1997</b>	8	10	7	13	9	5	0	1	4	0	0	57
<b>1998</b>	11	5	10	8	4	3	1	2	1	0	1	46
<b>1999</b>	14	8	7	4	5	3	5	2	0	0	0	48
<b>2000</b>	8	2	11	12	6	6	4	3	1	0	0	53
<b>2001</b>	7	11	8	6	7	3	1	3	2	0	1	49
<b>2002</b>	6	10	12	4	7	1	0	1	4	1	3	49
<b>2003</b>	6	9	6	5	3	0	1	-	-	1	2	33
<b>2004</b>	5	10	7	9	6	7	0	1	1	1	1	48
<b>2005</b>	4	12	14	9	6	7	3	5	-	3	3	66
<b>2006</b>	3	12	20	10	8	5	2	4	2	1	1	68
<b>2007</b>	6	13	14	12	8	7	5	5	1	5	1	77
<b>2008</b>	7	12	11	13	7	10	3	2	3	0	5	73
<b>2009</b>	3	26	16	18	12	9	2	6	4	0	5	101
<b>2010</b>	-	18	25	19	22	8	9	2	2	2	5	112
<b>2011</b>	5	14	15	14	7	6	10	1	4	1	12	89
<b>2012</b>	1	6	10	10	9	17	7	3	4	2	9	78
<b>2013</b>	3	9	12	7	10	5	9	10	3	2	6	76
<b>2014</b>	-	7	13	8	5	11	7	5	4	2	11	73
<b>2015</b>	2	4	8	7	12	9	4	7	3	4	16	76
<b>2016</b>	1	10	10	13	9	14	10	5	3	4	13	92
<b>2017</b>	3	8	17	12	7	7	6	5	3	3	10	81
<b>2018</b>	2	8	7	15	6	12	10	8	8	-	19	95
<b>Total</b>	<b>430</b>	<b>511</b>	<b>478</b>	<b>359</b>	<b>227</b>	<b>182</b>	<b>116</b>	<b>87</b>	<b>62</b>	<b>37</b>	<b>128</b>	<b>2,617</b>

Table 3 shows the authorship publication trend in tropical medicines, the rows show the years covered by the research, the number of authors that are 1-10, and the columns indicate the number of articles produced by authors within the years 1983-2018, with the intellectual production reaching its maximum between the years of 2009-2010 and minimum in 2003 and 1994. , showing the trends as shown in the table we can see that articles with two authors have the highest production followed by three authors than one author and four authors from there it began to decline but from articles with 10 authors and above it began to rise again. It can be seen that a single author started very well but with the years moving it declines whereas 2, 3, and 4 authors started poorly but with years going they kept improving. These data are represented in Figure 3.



**Figure 3. Comparing the total number of publications on tropical medicine in Nigeria based on the authorship pattern of documents that is from 1-10< authors**

### Discussion and Conclusion

In this study trend of publications on tropical medicine in Nigeria based on the WoS classification was studied these are articles, notes, proceeding papers, and reviews with each being shown based on scientific production. Articles have the maximum scientific production between the years under study from 1983-2018 with 2427 this may be due to the fact that articles are written individually and at the discretion of the individual authors making the authors choose the title of the article to write on, to look for the journal to submit for publication whether fees based journal or free based journal and also to work at their convenience to meet the submission deadline of the intended journal (Lv et al., 2011). It is also important that articles are written based on the authors' experience because the authors are not all based in the same location. Some may have more cases to write on than others, especially concerning the subject under study which is tropical medicine, the endemic, epidemic, vectors, and endemicity are different based on the location (Yin, 2013). Like the issue of malaria in northern Nigeria, chicken fox in southern Nigeria, river blindness in south-south Nigeria, Zika virus in South America, etc. Notes as research material come from the spot analysis of research findings usually during drug trials and administration in this case and also during clinical trials which demands coming together of a team to make a lot of consultations,



meetings, laboratory investigations, etc. out of what was obtained from the notes (Yang et al., 2013). Reviews come from both articles, notes to assess the similarity, results, or otherwise of research conducted repeated to obtain results and will not be the same in the location of the various authors as the findings are not the same in various research (van Rann, 1996). Proceeding papers are usually a collection of papers that were presented during a conference or seminar to add more knowledge to the existing one to the attendees of the said conference (Lisée et al., 2008).

Tropical medicine subjects were classified based on their categories in the WoS database which is based on the research areas (Falagas, Karavasiou & Bliziotis, 2006). This may be due to the fact that not all diseases are prevalent in all the locations around the world thus the categorization will help in studying the diseases according to their location, vectors, and endemic areas. Also important is the issue of research funding in accordance with the categorization, training, and re-training, which provides a lot of specialization options for the interested organization to invest their money on like pharmaceutical companies, nongovernmental organizations, etc. (Edejer, 1999).

Authorship trend in tropical medicines research is among the indices that were studied in this research thus showing publications with authors from 1-10 and their publications within the years under study. From the data collected one can see that single authorship started very but within a short period of time it came down and was overtaken by publications with two and three authors also publications with four authors played a significant role in the years before their decline (Morel et al., 2009). Publications with 10 authors and above started slowly but with time and with collaborations which is the backbone of any meaningful research it took over and keeps progressing over the time. Even though most of the authors wrote on the category of diseases that is prevalent in their locality but there is a great deal of collaboration between the authors from different parts of the world because there is intellectual interaction and exchange both in conferences, seminars, workshops, and training programs. It is mandatory for any medical doctor from the UK that want to specialize in tropical medicine to travel to any tropical country for one year to gain experience in tropical medicine diseases' management and control (Bender et al., 2015).

In conclusion, we can see that from the trend of the publication on tropical medicine where articles have the highest production followed by notes, reviews, and proceeding papers it told us that the research trend in tropical medicine in Nigeria is mostly individually sponsored because articles publication are mostly done individually through publications in journals and most of these journals are based outside Nigeria. In the WoS database, only three Nigerian journals are indexed these are the Nigerian Journal of Pharmaceutical Research, the Journal of Internal Medicine, African Journal of Library and Information Science. That is why notes, reviews, and proceeding papers are counted very low because these are areas that need fields researches, trials, and conference and seminar attendance which is financially intensive for them. As it is with virtually all or most African countries where corruption is endemic, looting and stealing from government

treasury is the order of the day making any meaningful fact in notes, reviews, and proceeding of conferences will be difficult because even sponsoring delegates to attend such conferences is not easy not to talk of conducting trials in the efficacy of drugs or otherwise. In Nigeria there is still a court case concerning Pfizer drug trials in the northern city of Kano administered on children in conjunction with corrupt government officials that left hundreds of the victims with various degrees of life-threatening injuries which can be reported on notes and proceeding papers but you cannot find such information why because they are trials that were conducted by the drug companies headed by corrupt people.

In the topics categories covered by the WoS database the situation is that most of the categories that were given importance are curative categories that need a readymade drug intervention and trials like infectious diseases, veterinary medicine, public and environmental health, etc., areas that are preventive and need a lot of funds for research were not given much coverage like microbiology, parasitology, and toxicology these areas need much attention but because the west have seen that these are areas that will improve public health and in the long run drop the exploitative drug market of the western countries and their companies nor much importance is given to those field of tropical medicine.

In the authorship pattern of tropical medicine publication within the period under study, it can be seen that single authorship started very well because most of this publication was self-sponsored, self-sourced from advertised journals, but with time reduced to the minimum, and joint authorship improved which gave rise to publications with three, four and two authors even that with time it was overtaken by ten authors and above that shows a remarkable increase in collaboration within the authors of these publications which may be due to more funding for researches either from the Nigerian government, funding agencies, or change of attitude from the authors themselves.

### **Author Contributions**

Conceptualization, A. A. A., F. S., S. A., Y. E., and S. J. G.; methodology, A. A. A., F. S., S. A., Y. E., and S. J. G.; software, A. A. A., F. S., S. A., Y. E., and S. J. G.; validation, A. A. A., F. S., S. A., Y. E., and S. J. G.; formal analysis, A. A. A., F. S., S. A., Y. E., and S. J. G.; investigation, A. A. A., F. S., S. A., Y. E., and S. J. G.; resources, A. A. A., F. S., S. A., Y. E., and S. J. G.; data curation, A. A. A., F. S., S. A., Y. E., and S. J. G.; writing—original draft preparation, A. A. A., F. S., S. A., Y. E., and S. J. G.; writing—review and editing, A. A. A., F. S., S. A., Y. E., and S. J. G.; visualization, A. A. A., F. S., S. A., Y. E., and S. J. G.; supervision, F. S. and S. J. G.; project administration, F. S. and S. J. G.; funding acquisition, F. S. and S. J. G. All authors have read and agreed to the published version of the manuscript.

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## Data Availability Statement

Data available on request from the authors.

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## Ethical considerations

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## Conflict of interest

The authors declare no conflicts of interest.

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