Library Progress International
Vol.44, No.2s, Jul-Dec 2024: P.1856-1872

Print version ISSN 0970 1052
Online version ISSN 2320 317X

Original Article

Available online at www.bpasjournals.com

Scientometric Analysis of Human Microbiome Research during 2002-2023

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How to cite this article: Keya Ghosh, Dhiraj Sharma, Ashok Kumar Upadhyay (2024) Scientometric Analysis of Human Microbiome Research during 2002-2023. *Library Progress International*, 44(2s), 1856-1872.

Abstract

This paper tried to analyze publications on "Human microbiome," globally over the last 22 years i.e. 2002- 2023 and summarize the most advanced achievements in this field, data retrieved from SCOPUS database. The total 3814 number of research publications found and extracted and further analyzed in selected parameters for fulfillment of the objectives of the study. This research aims to assess the global research productivity on the "Human microbiome." In respect of Literature Publications "United States" is at the top among the world with publications (TP=1858), followed by "China (TP=321)", "United Kingdom (TP=234)", "Germany (TP=216)", "Canada (TP=213)" and "India (TP=183)" in this field during this time. "Frontiers in Microbiology" is the most presiding journal in the field of "Human Microbiome" with 113 publications followed by "Plos One" with 100 publications. We use an open-source tool, VOSviewer for classic logical bibliometric analysis.

Keywords: Scientometrics, Human microbiome, Research productivity, Citation Impact, VOSviewer, Bibliographic coupling

1. Introduction

The term "**microbiome"** derived from the Greek *micro* meaning "small" and *bíos* meaning "life, the term was first used by J.L. Mohr in 1952 in The Scientific Monthly . **Joshua Lederberg** describes **"microbiome"** as "Ecological community of commensal, symbiotic and pathogenic microorganisms within a body space or other environment". The term "**human microbiome"** is an accumulation of all microbiota that resides into human tissues and biofluids and as well as in the anatomical sites · These anatomical sites include the gastrointestinal tract, ovarian follicles, mammary glands, uterus, skin, lung, conjunctiva, seminal fluid, saliva, oral mucosa, and the biliary tract. Human microbiota comes in various forms, such as viruses, fungi, protists, bacteria, and archaea. These microorganisms play a significant role in different bodily functions, including digestion, metabolism, immune system regulation, and protection against pathogens.

Now a days, the most popular evaluation technique for calculating scientific output of any entity's is scientometric study. Scientometric analysis is a quantitative and qualitative method used to evaluate different facets of scientific research, which is becoming more significant in research environment to recognizing and understanding current research trends and dynamics within certain research fields by researchers and academicians. Now, accountability and decision-making are major issues anywhere that evaluation plays a crucial part. There are many scientometric indicators are readily available to assess the research output of any Institution or on a Particular topic.

In this study we have taken up an initiative to measure the Scholarly literature outcome in the subject domain of "Human Microbiome" using Scientometric analysis during 2002 to 2023. As Human Microbiome inextricably play a vital role in human health and disease such as "Digestion and Nutrition Absorption," "Regulation of Immune System," "Protection Against Pathogens", "Drug Metabolism", "Inflammatory Bowel Disease (IBD) etc. Investigating global research outcome on "Human microbiome" can contribute valuable information to address public health challenges to the world. Including "Human microbiome" research, the global scientific community can foster international collaboration. This can enhance the overall quality of research by integrating diverse perspectives, methodologies, and findings. Collaborative research on Human microbiome within the world can contribute to capacity building and knowledge transfer. VOSviewer (Jalal, 2019) tools was used to create network plots to know the cooperative regions relating to authors, subject areas, and key-terms. The result of this study established that the year wise research growth on "Human Microbiome" in India as compared to other countries in the world.

2. Literature Review

Scientometricians frequently conduct both quantitative and qualitative analyses of scientific literature. Using statistical and mathematical techniques it helps academicians to understand the research hotspots, development, and current research status in this subject; and new developments in the research domain; and explain the relationship between the analysis unit using graphics and visualization. At present, there have been few scientometric studies conducted on 'Human Microbiome' research field and achieved certain findings. ***(Yuan et al., 2021)*** were carried out research on human gastrointestinal microbiome for the time January 2010 to February 2021 using Scopus database and term used "gastrointestinal microbiome" and its synonyms. Software tools used for this analysis was Cite Space 5.5.R2. 4444 articles on "human gastrointestinal microbiome" published in 1255 Journals. ***(Balachandran & Begum, 2019)*** also conducted a study on Human Microbiome extracted data from Web of Science for the time period 2009 to 2018.Total 12369 data was extracted out of Which 12109 are research articles, maximum number of publications 2248 in the year 2018. "PLOS ONE" is the leading Journal proffered by the Scientists. USA is at the top with highest number of publications 3814 followed by China with 806 publications.

(Deepa Azhchath Vasu et al., 2021) have conducted a scientometric study on mammalian microbiome research, data extracted from Web of Science for the time period 2007 to 2020.512 published articles were extracted and analysed, data extracted through Boolean search using keywords "Microbiome" and "Mammalian Microbiome". Within 512 records 356 are articles and 142 are reviews. "United States of America", is at the top followed by the UK. The highest number of articles (N=20) on mammalian microbiome published on "PLOS ONE".

(Trivedi et al., 2021) have conducted a bibliometric study on reproductive health. Data Extracted from Web of Science for the period 2011-2020, total 18186 scientific publications were retrieved. Study revealed that USA, UK and China have published more research paper in reproductive health. "Kissin DM" published maximum paper (91) but "Temmerman M" has received highest citations. "University of California "was the top institution in Reproductive health with 863 publications. This study also revealed that "Fertility and Sterility" was the most prolific Journal in this field within 2011 to 2020.

3. Objectives

Objectives of this present study are –

- Analyze year wise publication output from 2002 to 2023, open access vs non-open access publications, type of documents published.
- Identify top articles and journals and most prolific authors based on total citations received
- Find out most productive countries and country collaboration analysis
- Measure Degree of Collaboration of authors
- To identify most used keywords in this domain
- To represent bibliometric data visualization using analyzing tool VOSviewer for co-authorship, citation, co-occurrence of keywords and Bibliographic Coupling analysis in the Domain of "Human Microbiome."

4. Methodology

The study focused on last twenty-three years of comprehensive research productivity on "Human Microbiome." We collected the data of 3814 documents from the Scopus database and then tabulated and analysed the data importing it into Microsoft Excel. Based on its versatility for organising and presenting the retrieved data, Microsoft Excel was used. Visualization analysis of retrieved data was done by Version 1.6.19 VOS viewer software. Data extract for the present Scientometrics study is the Scopus multidisciplinary database product of Elsevier. It covers approximately 27,950+ active titles from 7,000+ publishers, of which 26,591+ are peer reviewed journals (covers 330 disciplines). Scopus has various search options based on bibliometric attributes of a publication.

This area was preferred due to its vast literature coverage. Only Scopus indexed documents were collected from 2002 - 2023 and no language barrier was there if the term "Human microbiome" is included in titles, abstracts, and keywords. The search query performed was - TITLE-ABS-KEY ("Human Microbiome") AND PUBYEAR > 2001 AND PUBYEAR < 2024. As the citations might change on daily basis and so the bibliometric indicators, we retrieved all the data at once and on the same day (13/05/2024) we collected the other necessary bibliometric information and prolific data such as –documents with most citations, most prolific authors, best journals, top institutions, leading countries, and funding agencies, to avoid any difference in data. A bibliometric data visualization tool like VOSviewer (version 1.6.19) has been used in this study for visual representation of the relationship among various authors, organizations, Nations, key terms. The relation between items based on their repetitions, co-authorships and co-citations is highlighted. Bibliographic coupling ***(Eck & Waltman, 2009)***, was used to realize the connection between repetitions and terms along with most co-authorship of authors and Nations. The yearly publications growth, the publications with most citations, prolific journals and prolific institutions, prolific countries, prolific funding agencies. VOS viewer is a free bibliographic tool used for data mapping. The collected data were imported to VOSviewer v.1.6.19 (https://www.vosviewer.com/) for data analysis This tool has been used to present visual network maps which demonstrate research collaboration and research hotspots ***(Eck & Waltman, 2009)***.

5 Data Collection and Analysis

Table: 1 Main Information about Human Microbiome publication data

Description	Results
Time span	2002:2023
Sources	1577
Documents	3814
Total Citation	238462
Average Annual Growth Rate %	-27.17%
Document Average Age	5.44
Average Citations Per Doc.	62.522%
References	232356

Type of documents	10
Index keywords	17186
Author's Keywords (DE)	8310
Authors	3666
Authors of Single authored documents	373
Single-authored Docs.	920
Multi –authored Docs.	2870
Anonymous	24
Co-authors per paper	1.277
Degree of Collaboration	0.758
Major Languages	6(English, Russian, German, Chinese, Polish, Spanish)

The table (1) summarizes the main data extracted from Scopus in the field of Human Microbiome research during the period of 2002 to 2023. It presents insightful information regarding the nature and type of research being done in the area. A total of 1577 sources, including all type of documents were used as part of the research. The area of study involved the analysis of 3814 documents, which could be article, review, conference papers or other forms of written content. A considerable number of 238462 citations were made throughout the study, indicating the thorough use of prior research and literature to support the study. The calculated yearly growth rate is -27.17%. This could indicate that, throughout the course of the study, there were less documents or citations on average every year.

An average age of the documents which were analysed is 5.44 years. This suggests that the documents of this study are recent. On average, each document has received 62.522 citations. This indicates the level of impact and acceptance of the research presented in the documents of this domain. The study of the document revealed that citation of 232356 references were made which proved the depth of research and the amount to which other works were consulted. The dataset includes 17186 Index keywords and 8310 author keywords to describe the content of the documents. The study involves the work of 3666 authors collectively. 373 of the documents had a single author, indicating that they were written by a single author. There were 920 documents written by a single author. Each paper has 1.277 co-authors on average, indicating a degree of scientific collaboration. Although other factors like research quality and variations in publication trends may also play a role, the negative annual growth rate points to a potential decline in the number of documents or citations over time.

5.1 Publication vs Citation

Table 2 depicts the distribution of number of publications chronologically on “Human Microbiome” from 2002 to 2023. It is observed that during the last 22 years (2002-2023) the total number of publications on “Human Microbiome” is 3814. We have also observed from the data, the highest number of Publications in the year 2022 with 487 publications (12.768%) and first Scopus indexed Journal on “Human Microbiome” is in the year 2002. It is also observed that the publications productivity of this subject domain “Human Microbiome”” had slowly increased after 2007. In respect of citations 2012 received highest citations 40148, followed by the year 2017 with citations 20232.Time of citations received (CT) reflects that in the 2014 received highest 14980 citations. Year wise Average Citations per Paper (ACPP) it is reflected that 2002 record is the highest with 2083.5 and Average citations per paper during the time span (2002-2023) is 62.522.

Table 2: Publication vs Citation						
Year	**NP**	**P**	**CT**	**ACPP**	**Citation sum within h-core**	**h-index**
2002	1	0.0262	100	100	100	1
2003	0	0	0	0	0	0
2004	0	0	0	0	0	0
2005	0	0	0	0	0	0
2006	0	0	0	0	0	0
2007	2	0.052	4167	2083.500	4167	2
2008	18	0.472	3688	204.888	3675	14
2009	23	0.603	5487	238.565	5468	16
2010	38	0.996	8853	232.973	8759	22
2011	79	2.071	16913	214.088	16545	35
2012	146	3.828	40148	274.986	38552	70
2013	140	3.670	19857	141.835	18081	55
2014	210	5.506	18655	88.833	15614	73
2015	211	5.532	15667	74.251	12666	72
2016	225	5.899	22086	98.160	18696	69
2017	271	7.105	20232	74.656	16538	60
2018	316	8.285	18287	57.870	13391	65
2019	364	9.543	20145	55.343	14923	72
2020	388	10.173	10138	26.128	5570	49
2021	439	11.510	8151	18.567	4231	41
2022	487	12.768	4395	9.024	1689	29
2023	456	11.955	1493	3.274	584	15
Total	**3814**	**100**	**238462**	**62.522**		

NP=Number of Publications, **CT**=Citations Count, **P**=Percentage, **ACPP**= Average Citations Per Paper

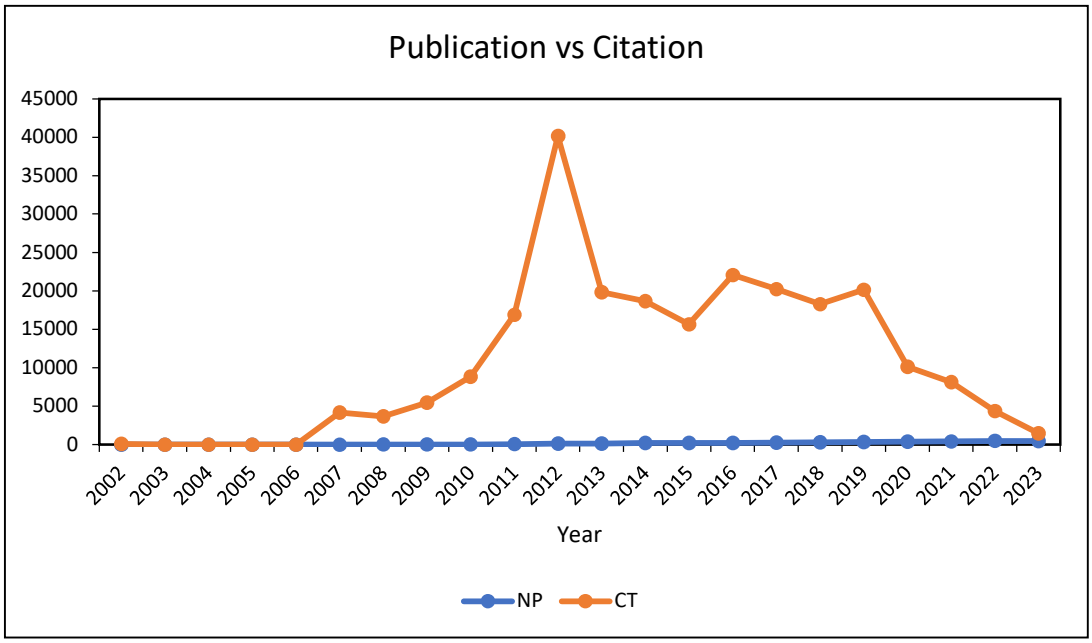

Fig 1 Graphical representation of Publication vs Citation

5.2 Open Access Vs Non-open access Publications

Research publications are either open access or non-open access. Any publication will be called as open access if no barriers is there in terms of financial and legal aspects for accessing it. Without any constraints such type of research publications can be downloaded, read, or distributed freely. In open access research contributions get more visibility and can be easily accessible among masses in research community. In Gold Open access the content related to publication s of articles is made available free of cost on the website of journal immediately after completing their production stage, usually authors are required to pay article processing charges and bear all cost of publications instead of readers. In case of green open access publisher usually places manuscripts of authors into the repository making it available at free of cost for all readers

Table 3 depicts the year wise contributions of Open Access and Non-Open Access publications with citation received. Here Number of citations received denoted by CT. Average Citations per paper denoted by ACPP. If we compare both the type of publications contributions, Open access Publication's contributions are remarkably more than non-open access.

Table 3: Publication vs Citation

	Open Access				Non-Open Access			
YEAR	**NP**	**P**	**CT**	**ACPP**	**NP**	**P**	**CT**	**ACPP**
2023	323	70.833	1189	3.6811	133	29.166	304	2.2857
2022	330	67.761	3762	11.4	157	32.238	633	4.0318
2021	328	74.715	7187	21.911	111	25.284	964	8.6846
2020	285	73.453	8573	30.080	103	26.546	1565	15.1941
2019	234	64.285	17260	73.760	130	35.714	2885	22.192
2018	200	63.291	15633	78.165	116	36.708	2654	22.879
2017	182	67.158	18621	102.313	89	32.841	1611	18.101

2016	145	64.444	19970	137.724	80	35.555	2116	26.45
2015	129	61.137	12144	94.139	82	38.862	3523	42.963
2014	142	67.619	16446	115.816	68	32.380	2209	32.485
2013	98	70	18704	190.857	42	30	1153	27.452
2012	103	70.547	35949	349.019	43	29.452	4199	97.651
2011	40	50.632	15031	375.775	39	49.367	1882	48.256
2010	23	60.526	7870	342.173	15	39.473	983	65.533
2009	15	65.217	5221	348.066	8	34.782	266	33.25
2008	10	55.555	3222	322.2	8	44.444	466	58.25
2007	1	50	4113	4113	1	50	54	54
2006	0		0					
2005	0		0					
2004	0		0					
2003	0		0					
2002	1	100	100	100				0
TOTAL	**2589**	**67.8814**	**210995**	**81.4967**	**1225**	**32.11**	**27467**	**22.4220**

5.3 Type of Document Published

From the collected dataset of 3814 documents on "Human Microbiome" from Scopus, major documents are Journal articles (n=2126,55.74%), followed by review articles (n=1068,28%), book chapter (n=287,7.52%), Conference paper (n=121,3.17%), Note (n=68,1.78%), Editorial (n=54,1.415%), short survey (n=36,0.943%), Book (n=18,0.471%), Letter (n=16,0.419%), Retracted (n=1,0.026%). Maximum number of articles are published in English (n=3656,95.85%), followed by Russian language (n=46, 1.20), German (n=31, 0.812%), Chinese (n=30, 0.786%), Polish (n=16, 0.419%), Spanish (n=11, 0.288%) and 41 are in other language.

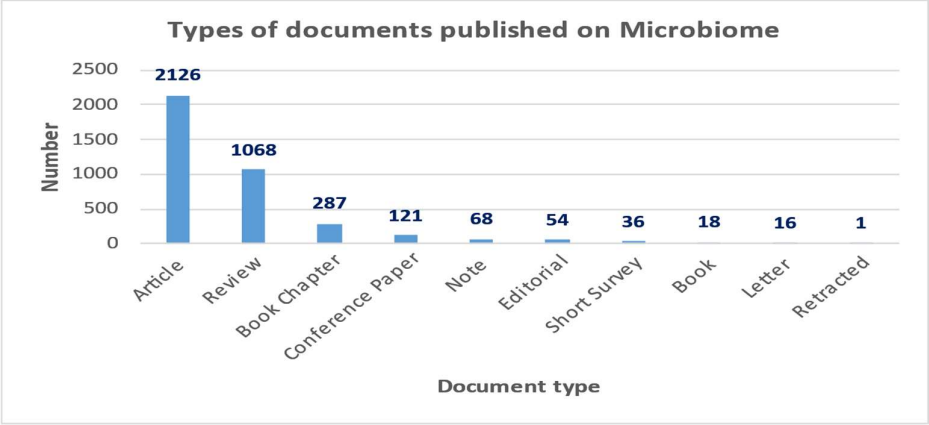

Fig.2 Type of Document

5.4 Top 15 articles

Table 4 depicts the top fifteen articles based on most citations received. The article "Structure, function and diversity of healthy human microbiome" is the best article based on highest citations (8061) received during the time 2002-2023, followed by "Predictive functional profiling of microbial communities using 16S rRNA marker gene sequences" with citations (6693).

Table 4: Top 15 articles based on Citations during the period 2002-2023						
Rank	**Title of the Document**	**Year of Publication**	**No. of Citations**	**Source of Publication**	**ISSN (Online)**	**CiteScore**
1	Structure, function and diversity of the healthy human microbiome	2012	8061	Nature	1476-4687 (online)	83.4
2	Predictive functional profiling of microbial communities using 16S rRNA marker gene sequences	2013	6693	Nature Biotechnology	1546-1696	71.9
3	Global patterns of 16S rRNA diversity at a depth of millions of sequences per sample	2011	6322	Proceedings of the National Academy of Sciences of the United States of America	0027-8424	19.2
4	Introducing EzBioCloud: A taxonomically united database of 16S rRNA gene sequences and whole-genome assemblies	2017	5399	International Journal of Systematic and Evolutionary Microbiology	1466-5034	4.5
5	The Human Microbiome Project	2007	4113	Nature	1476-4687	83.4
6	An improved Greengenes taxonomy with explicit ranks for ecological and evolutionary analyses of bacteria and archaea	2012	3793	ISME Journal	1751-7370	20.4
7	Delivery mode shapes the acquisition and structure of the initial microbiota across multiple body habitats in newborns	2010	3388	Proceedings of the National Academy of Sciences of the United States of America	0027-8424	19.2
8	Vaginal microbiome of reproductive-age women	2011	2655	Proceedings of the National Academy of Sciences of the United States of America	0027-8424	19.2
9	The human microbiome: At the	2012	2372	Nature Reviews Genetics	1471-0064	69.7

	interface of health and disease					
10	Microbial interactions: From networks to models	2012	2346	Nature Reviews Microbiology	1740-1534	60.2
11	Gut Microbiota Regulate Motor Deficits and Neuro inflammation in a Model of Parkinson's Disease	2016	2249	Cell	1097-4172	102.0
12	A framework for human microbiome research	2012	1951	Nature	1476-4687	83.4
13	Incomplete recovery and individualized responses of the human distal gut microbiota to repeated antibiotic perturbation	2011	1704	Proceedings of the National Academy of Sciences of the United States of America	0027-8424	19.2
14	The NIH Human Microbiome Project	2009	1528	Genome Research	1549-5469	14.6
15	Inferring Correlation Networks from Genomic Survey Data	2012	1470	PLoS Computational Biology	1553-7358	7.1

5.5 Top 10 Journals based on total citation received

Table 5 reveals the top ten Journals based on total citations received. The "Nature" is the most prolific journal in terms on total citations (22599) received during the time span 2002-2023, followed by "Proceedings of the National Academy of Sciences of the United States of America" with 20568 citations. It is observed that although Nature has only 32 publications in this subject area during this period but still it managed to gain most citations in this field. The article "Structure, function, and diversity of the healthy human microbiome" having highest citations (8061) is also published in Nature journal.

Table 5 : Top 10 Journals based on total citation received

Rank	Name of the Journal	No. of Documents	No. of Citations	ISSN (Online)	CiteScore	h-index
1	Nature	32	22599	1476-4687	83.4	23
2	Proceedings of the National Academy of Sciences of the United States of America	38	20568	0027-8424	19.2	33
3	PLoS One	100	8293	1932-6203	5.6	48
4	Nature Biotechnology	11	7940	1546-1696	71.9	9
5	Microbiome	76	6882	2049-2618	**24.5**	**40**

6	Nature Reviews Microbiology	11	6831	1740-1534	60.2	8
7	Cell Host and Microbe	40	6370	1934-6069	36.2	34
8	Cell	23	6151	1097-4172	102.0	20
9	Frontiers in Microbiology	113	5698	1664-302x	8.2	32
10	PLoS Computational Biology	28	5485	1553-7358	7.1	19

5.6 Top 10 Prolific Author

Table 6 depicts the author productivity and citations received during study period on "Human Microbiome" domain. Knight, Rob of United States is the most prolific author with 78 publications and 56089 citations followed by Huttenhower, Curtis with 58 publications and 31518 citations.

Table 6: Top 10 Prolific Author

Sl. No.	Author Name	TP	TC	h-Index	ACPP	Institution	Country
1.	Knight, Rob	78	56089	56	719.09	University of California	United States
2.	Huttenhower, Curtis	58	31518	42	543.41	Broad Institute, Cambridge	United States
3.	Segata, Nicola	31	17302	24	558.13	Università di Trento	Italy
4.	Versalovic, James	27	13374	22	495.33	Texas Children's Hospital	United States
5.	Blaser, Martin J.	26	16342	21	628.54	Children's Hospital of Winnipeg	Canada
6.	Raoult, Didier A.	25	1540	16	61.6	Aix Marseille Université, Marseille	France
7.	Gevers, Dirk	23	17238	22	749.47	Seed Health, Venice,	United States
8.	Gilbert, J.A.	22	2500	16	113.64	Info The University of Chicago	United States
9.	Turnbaugh, Peter James	21	13182	20	627.71	UCSF School of Medicine, San Francisco	United States
10.	Franzosa, Eric A.	20	5756	19	287.5	Harvard T.H. Chan School of Public Health, Boston	United States

5.7 Top 10 productive countries with citations

Table 7 reveals that during the period of study the United States is most productive country with publications (TP=1858, TCC=171453), followed by China (TP=321, TCC=9598), United Kingdom (TC=234, TCC=13408), then Germany (TP=216, TCC=14839), Canada (TP=213, TCC=27881), Australia (TP=138, TCC=11927).

Table 7: Top 10 productive countries with citations							
Sl. No.	**Name of the country**	**Total Publications (TPs)**	**Total Citations (TCs)**	**Percentage against total citation received**	**Average Citation per Publications (ACPPs)**	**Total Publication Rank (TPR)**	**Total Citation Rank (TCR)**
1.	United States	1858	171453	71.89	92.27	1	1
2.	China	321	9598	4.24	29.90	2	6
3.	United Kingdom	234	13408	5.62	57.29	3	4
4.	Germany	216	14839	6.22	68.69	4	3
5.	Canada	213	27881	11.69	130.89	5	2
6.	India	183	3312	1.38	18.09	6	10
7.	Italy	165	7856	3.29	47.61	7	7
8.	France	149	6980	2.92	46.84	8	8
9.	Australia	138	11927	5.00	86.42	9	5
10.	Spain	106	5748	2.47	54.23	10	9

5.8 Country Collaboration:

Further, we examined the partnership of countries in publications of the field of "Human Microbiome "and the result has been showed in Fig. 3 To accomplish such conclusions, among 3814 articles those having author collaboration, when performed the analysis taking minimum number of documents of a country 25 out of 139 countries 35 meets the requirement evaluated the adequacy of the co-authorship links with other Countries for each of 35 countries. The countries having exceptional link strength has been picked. United States is the Pioneer in the field of "Human Microbiome" with 1864 documents and 99382 citations. There are 4 clusters for 35 items, 532 links and total link strength is 3097.

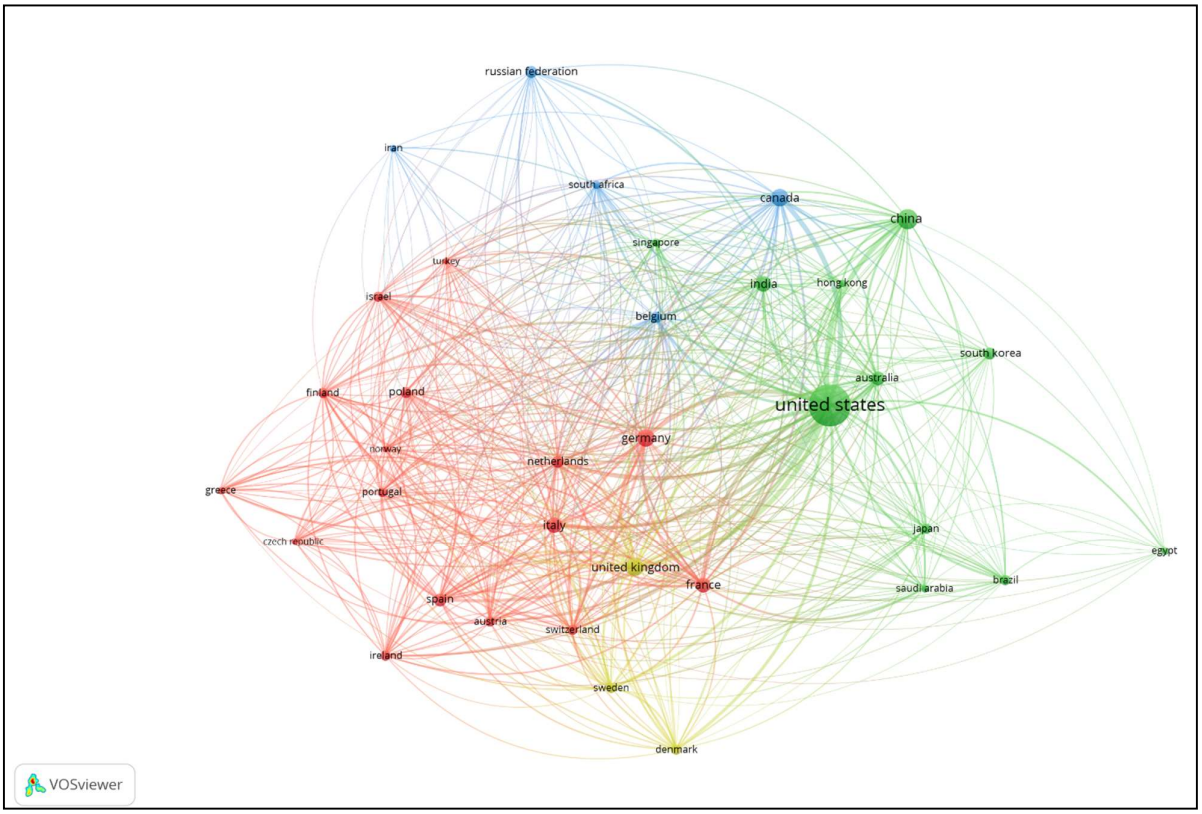

Fig. 3: Country Collaboration based on authors

5.9 Degree of Collaboration:

According to K. Subramanyam Degree of Collaboration is a measure used in bibliometrics to assess that how much research is done in collaboration within a scholarly community or a particular field of study during a certain period.

DC=Nm / Ns + Nm
DC= Degree of Collaboration
Ns=Single Authored papers
Nm=Multiple Authored papers

Here Ns=920 and Nm=2894

DC=2894/920+2894=0.758

The following table (Table: 7) reveals the authorship patterns of "Human Microbiome" research papers. The table 7 depicts that large number of Publications (75.87%) are by multiple authored, Single author publication 920 (24%).

Table 7: Degree of Collaboration										
	Ns	**Nm**								**Total**
	1	2	3	4	5	6	7	8	≥9	
NP	920	547	529	412	276	241	200	154	535	

	920	2894								
P	24.12	14.34	13.86	10.80	7.236	6.31	5.24	4.03	14.027	100
Ns=Single Authored papers, **Nm**=Multiple Authored papers, **NP**=Number of Publications, **P**= Percentage										

Figure 4 reveals that in this study most of the documents are written by multiple author (2894,76%) and single authored documents are (920,24%).

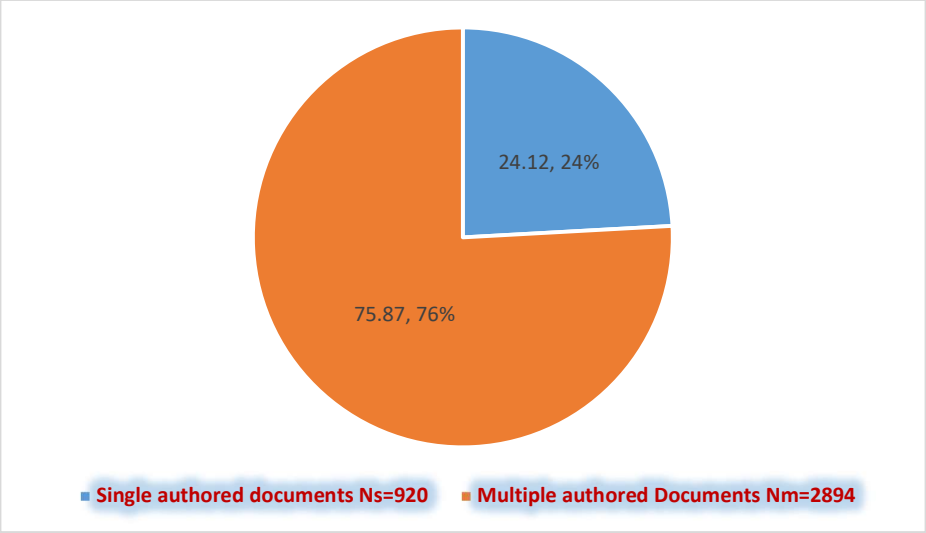

Fig. 4: Degree of Collaboration based on authors

5.10 Co-occurrences of Author Keywords

The following Fig. 5 shows the co-occurrence of author keywords in the field of Human Microbiome publication. To get adequate visual map, here we consider minimum number of occurrences of a keyword 30. Then out of 7035 keywords 35 meet the requirements. Top five keywords are “Microbiome” (891), “Human microbiome” (567), “Microbiota” (292), “Metagenomics” (268), “Dysbiosis” (185).

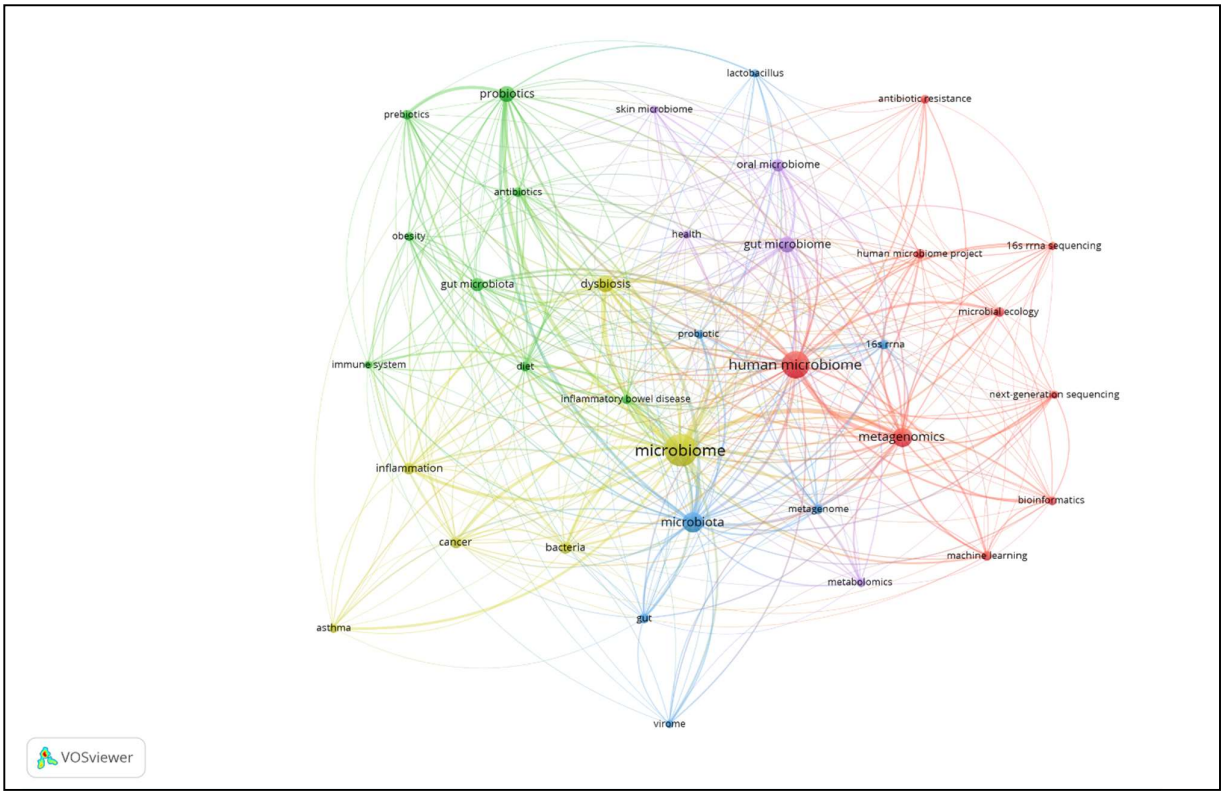

Fig. 5: Co-occurrences of Author Keywords

5.11 Co-occurrences of All keywords

The closer keywords in network visualization map, they are more closely related and work together to form a cluster (Van Eck and Waltman,2010). From selection of keywords theme of research can be understand. Fig. 6 depicts the keywords co-occurrence network visualization of all keywords. It indicates which keywords are repeatedly used in different research papers in the domain of "Human Microbiome "this also help the other researchers to understand principal area of the work. Here we consider number of keyword occurrence 500 for a word, then out of 19940 keywords 21 meet the requirement. From this study it is observed that following top five keywords are "Human" (2713)," Humans" (2112)," nonhuman" (1858)," Microbiome" (1867)." Microbiota" (1515).

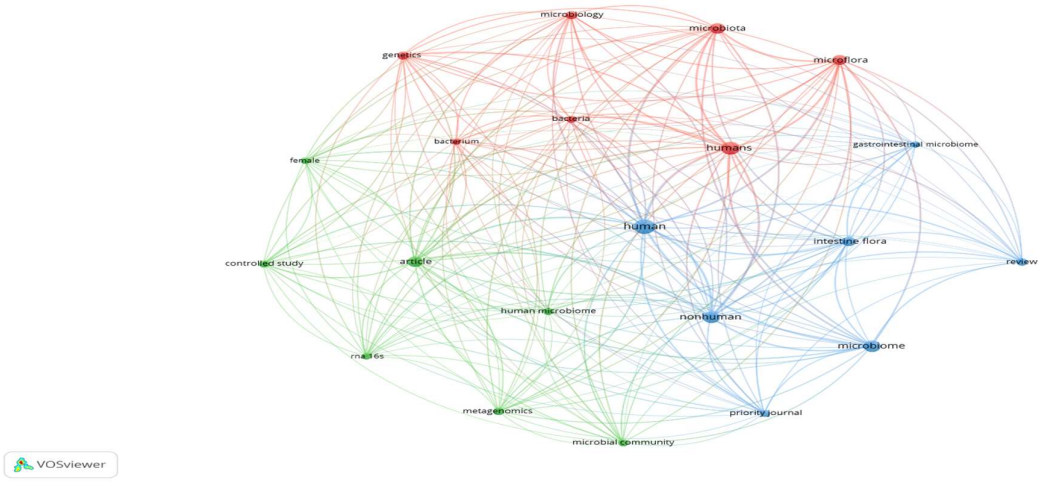

Fig. 6: Co-occurrences of Author Keywords

5.12 Bibliographic Coupling of Authors

Bibliographic coupling is the usages of two works citing the same third work in their bibliographies. It implies that there's a possibility of two articles are on the same subject. If two documents cite the same document or research papers together, they are considered as bibliographically linked.

Fig. 7 depicts the bibliographic coupling of authors. In this case we considered the minimal quantity of papers written by an author is 2, out of 3710 authors 88 meeting the standards. The largest set of related things, with 70 items out of 88, is as follows.

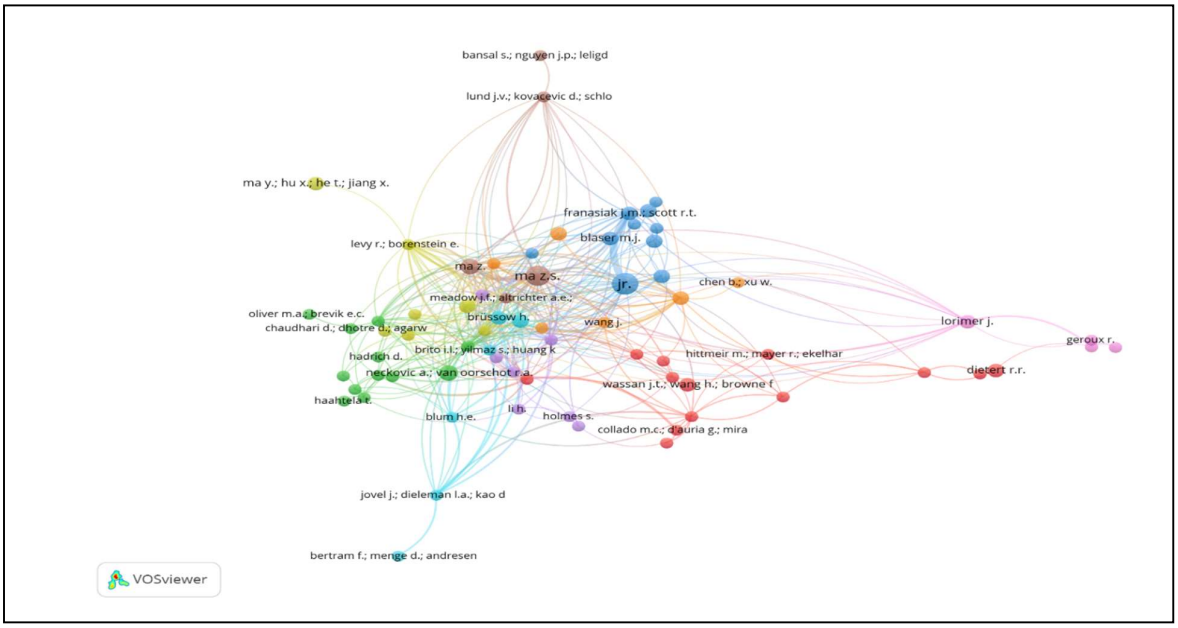

Fig. 7: Bibliographic Coupling of Authors

6 Limitations & Scope:

The present study has been carried out to measure the global research productivity in the domain of Human microbiome during last 22 years by retrieving data from Scopus database .In the process of data extraction, it has

also been observed that many research papers and other scientific works we are not included in the Scopus , the most three databases in this fields such as Google Scholar, PubMed, Web of Science were not considered in this study which may provide more valuable impacts on current research trends and research performance in the field of "Human microbiome".

The present study has the potential to significantly impact on public health policies, clinical practice, research advancement, and promotion of outreach and education initiatives in the domain of science of microbiome. Identifying key researchers and institutions in the field of human microbiome that can help in interdisciplinary collaborations. The Scientometric analysis in this field identify the gaps in research in this domain that received less attention and this will help new researchers in this field in prioritizing research efforts and allocating resources effectively.

7 Conclusion:

This study finds out the research productivity in the field of "Human Microbiome." The present study analysed a total 3814 publications retrieved from Scopus database during the time 2002 to 2023. The study revealed that there is slow growth of publication from 2002 to 2007 then from 2008 to 2022 there is a steady growth of Literature in the field of "Human microbiome". United States, China, United Kingdom, Germany Canada have published more research paper in the "Human Microbiome" domain. India is at the 6th position based on research productivity. Nature is the most prolific journal based on citations. Knight, Rob, published a maximum no. of publications 78 with citations 56089 followed by Huttenhower, Curtis with 58 publications and 31518 citations both the authors are from United States. Among top 10 authors of this field 7 authors are from United States. Highly cited articles are published in Nature, Nature Biotechnology, Proceedings of the National Academy of Sciences of the United States of America journals, top three documents received citations more than 6322. The finding also revealed that "Frontiers in Microbiology" and "PLoS One" are two highly productive Journals in this domain. Large number of publications are multi- authored (2894,76%) and only 24% articles single authored (920). Out of 3814 publications 2126 (74%) were articles. Maximum number of articles are in English (95.85%). It has been observed that the number of citations in open-access versus non-open-access differs significantly. Open access publications have gained more citations (81.5%) than non -open access publications (22.4%). Open access publications rate increases over the year whereas non-open access publications rate mostly decreases as compare to open access. VOS Viewer analysis tool used for data visualization. The study outcomes also revealed that Human, Nonhuman, microbiome, Human microbiome, microbiota were the frequently occurred keywords in this domain.

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