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Systematic Review

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Research trends in polio during the last 50 years: A bibliometric analysis

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ABSTRACT

BACKGROUND & OBJECTIVE: Many polio cases have been reported in recent years, which strongly affect the Global Polio Eradication Initiative campaign. This study aimed to determine the global trends in polio research during the last fifty years.
METHODOLOGY: An online search was conducted utilizing the Web of Science Core Collection database. The key term used was "Polio*" and the retrieved documents were assessed for several attributes. The required graphs were generated using OriginPro 2018. Furthermore, the data were plotted for co-authorship organizations, co-authorship countries, and co-occurrence author keywords network visualization mapping using VOSviewer software for windows.
RESULTS: A total of 2,345 publications were included, cited 22,872 times. The year 2017 was the most frequent year with 162 (6.91%) publications. The paper authored by Nomoto and colleagues published in 1977 was the leading paper with 237 citations. In total, Vaccine was the leading journal with 168 (7.16%) publications, followed by Journal of Infectious Diseases 106 (4.52%), and Lancet 77 (3.28%). The included publications were published from 132 countries, of which 44 countries contributed ≥10 publications. The United States of America was the leading country with the highest number of publications (n=740, 31.56%), followed by India (n=215, 9.17%), and England (n=180, 7.68%).
CONCLUSION: This study provide researchers and policy makers with a comprehensive list of the key bibliometric characteristics and major contribution in polio research. Majority of the studies were published in developed countries. The developing countries need to make strong research collaborations with developed countries.
KEYWORDS: Polio, Bibliometric analysis, Web of Science, VOSviewer.

INTRODUCTION

Poliomyelitis, usually shortened to polio, is a poliovirus-induced infectious disease. The disease is mainly contracted by children under five years of age. Since 1998, cases due to Wild Polio virus (WPV) have been decreased by over 99% worldwide. The disease mainly leads to permanent paralysis of different parts of the body, and it can eventually cause death by immobilizing the breathing muscles of the patient [1]. In recent years, a number of polio cases have been reported in polio endemic countries (Afghanistan and Pakistan) [2], which strongly affect the Global Polio Eradication Initiative (GPEI) campaign [3]. The media announced that Africa is now polio free after reporting the last polio case a few years ago in Nigeria. Four out of six World Health Organization (WHO) regions have been certified free of WPV circulation since the beginning of the Poliomyelitis Eradication Program, the American (1994), the Western Pacific (2000), the European one starting in 2002, and South East Asia as of 2014, respectively [4]. Polio was detected in Nigeria in 2016, following the last detected case in 2018.

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Through the WHO GPEI, there has been a significant drop of 99% [5]. Unexpectedly, according to the GPEI statistics, eleven African countries suffer from vaccine-derived poliovirus (cVDPV) outbreaks. On the other side, new WPV cases have been reported from both Afghanistan and Pakistan in 2019 [6]. Both countries are a serious threat towards polio eradication program and might be the risk of spreading polio to other parts of the world [6]. Almost 20 years after the global WPV eradication target of the year 2000, live polioviruses continue to circulate, with all three serotypes presenting challenges to the endgame of polio [7].

This bibliometric study aimed to determine the global research trends in polio in the last 50 years, provide baseline information to health personals, policymakers, and researchers to prepare the plan in the light of previous results and histories, and focus on the hotspots preferably.

METHODOLOGY

A retrospective bibliometric study was conducted. The online search was conducted on January 13, 2020, utilizing the Web of Science Core Collection (WoSCC) database. The search term used was "Polio*" in the title field. The search term Polio* searches for polio, poliovirus, polio virus, and poliomyelitis. The search was limited to year of publications (1970-2019), and document types (articles, editorials, letters, proceedings, papers, and reviews). The data were downloaded both in comma-separated value and plain text format. Two authors screened the articles and collected the data. The information collected includes; study titles, journals, authors, publications year, document types, organizations, funding sources, and countries. The journal impact factor (IF) was obtained from Incites Journal Citation Reports for the year 2018 (released in June 2019) by Clarivate Analytics.

The obtained data were imported into Microsoft Excel 2016 and OriginPro 2018 for quantitative and qualitative analysis. The required graphs were generated using the OriginPro 2018. Network visualization mapping was constructed through VOSviewer software for windows [8]. The data were plotted for co-authorship organizations, co-authorship countries, and co-occurrence author keywords network visualization mapping. In the current study, no animal or human subjects were recruited directly; therefore, ethical consideration was not required.

RESULTS

The initial search retrieved 3,566 publications, of which 2,345 publications were included in the final analysis, and cited 22,872 times (9.75 average citations per item). The overall h-index was 56. The trend of publications shows that maximum number of publications were published in 2017 (n=162, 6.91%), followed by in 2016 (n=141, 6.01%), in 2014 (n=140, 5.97%), in 2015 (n=120, 5.12%), and in 2018 (n=105, 4.48%) as shown in Figure-I.

3.1. Top ten most cited publications. Among the top ten most cited publications, only 5 publications were cited above 150 times. The citations were ranged from 129 to 237 times (Table-I). The paper titled "Location of polio genome protein in viral RNAs and its implications for RNA-synthesis" authored by Nomoto et al. published in 1977, was the leading paper with 237 citations.

3.2. Publication categories. Of the total included publications, Immunology was the most dominant discipline (n=441, 18.81%), followed by Medicine (n=374, 15.95%), and Public Environmental Occupational Health (n=359, 15.31%).

3.3. Documents types. In total, majority of the publications were original articles (n=1480, 63.11%), followed by editorial (n=358, 15.27%), letters (n=319, 13.60%), proceedings papers (n=96, 4.08%), and reviews (n=92, 3.91%).

3.4. Funding agencies. Maximum number of publications were funded by United States Department of Health Human Services (n=119, 5.08%), followed by Bill & Melinda Gates Foundation (BMGF) (n=95, 4.05%), WHO (n=83, 3.54%), Centers for Disease Control Prevention (CDC), United States of America (USA) (n=62, 2.64%), National Institutes of Health (NIH), USA (n=56, 2.39%), Skane County Council Research and Development Foundation (n=18, 0.77%), Stiftelsen for Bistand at Rorelsehindrade I Skane (n=15, 0.64%), Swedish Research Council (n=14, 0.60%), Wellcome Trust (n=13, 0.55%), and National Institute of Allergy Infectious Diseases, USA (n=12, 0.51%).

3.5. Distribution of authors. Highest number of publications were authored by Anonymous authors (n=53, 2.26%), followed by Sutter RW (n=34, 1.45%), Lexell J (n=31, 1.32%), Aylward RB (n=30, 1.28%), John TJ (n=30, 1.28%), Mkanda P (n=29, 1.24%), Borg K (n=28, 1.19%), Nsubuga P (n=28, 1.19%), Pallansch MA (n=25, 1.07%), and Arya SC (n=24, 1.02%).

3.6. Distribution of journals. In total, Vaccine was the leading journal with 168 (7.16) publications, followed by Journal of Infectious Diseases 106 (4.52%), and Lancet 77 (3.28%), as shown in Figure-II.

3.7. Distribution of countries. The included publications in this analysis were published from 132 countries. The USA was the leading country with highest number of publications (n=740, 31.56%), followed by India (n=215, 9.17%), England (n=180, 7.68%), Switzerland (n=155, 6.61%), Sweden (n=137, 5.84%), Netherlands (n=98, 4.18%), Pakistan (n=97, 4.14%), France (n=73, 3.11%), Nigeria (n=2.86%), and Israel (n=61, 2.60%).

3.8. Distribution of languages. The highest number of publications were published in English (n=2,226, 94.93%), followed by German (n=54, 2.30%), French (n=23, 0.98%), Spanish (n=20, 0.85%), Italian (n=5, 0.21%), Portuguese (n=5, 0.21%), Polish (n=4, 0.17%), Russian (n=0.09%), Czech (n=1, 0.04%), and Estonian (n=1, 0.04%).

Table-I: Top ten most cited publications in polio research.

Ranking	Title	Authors	Journal	Publication Year	Total Citations	Average Citations Per Year
1	Location of Polio Genome Protein in Viral RNAs and its Implication for RNA-Synthesis	Nomoto A, et al.	Nature	1977	237	5.39
2	New Problems in Old Polio Patients - Results of a Survey of 539 Polio Survivors	Halstead LS & Rossi CD	Orthopedics	1985	196	5.44
3	Local Antibody-Response to Polio-Vaccine in Human Female Genital Tract	Ogra Pl & Ogra SS	Journal of Immunology	1973	193	4.02
4	New Strategies For The Elimination of Polio From India	Grassly NC, et al.	Science	2006	175	11.67
5	Mucosal Immunity Induced by Enhanced-Potency Inactivated and Oral Polio Vaccines	Onorato IM, et al.	Journal of Infectious Diseases	1991	163	5.43
6	Genome-Linked Protein of Picornaviruses .3. 5'-Terminal Structures of Polio-Virion RNA and Poliovirus Messenger-RNA Differ Only in Genome-Linked Protein VPG	Nomoto A, et al.	Proceedings of the National Academy of Sciences of the United States of America	1977	146	3.32
7	What Led to the Nigerian Boycott of the Polio Vaccination Campaign?	Jegede AS	PLoS Medicine	2007	138	9.86
8	Transmissibility and Persistence of Oral Polio Vaccine Viruses: Implications for the Global Poliomyelitis Eradication Initiative	Fine PEM & Carneiro IAM	American Journal of Epidemiology	1999	138	6.27
9	Oral Polio Vaccination of Children in Tropics .1. Poor Seroconversion Rates and Absence of Viral Interference	John TJ & Jayabal P	American Journal of Epidemiology	1972	136	2.78
10	Proteolytic Processing in the Replication of Polio and Related Viruses	Nicklin MJH, et al.	Bio-Technology	1986	129	3.69

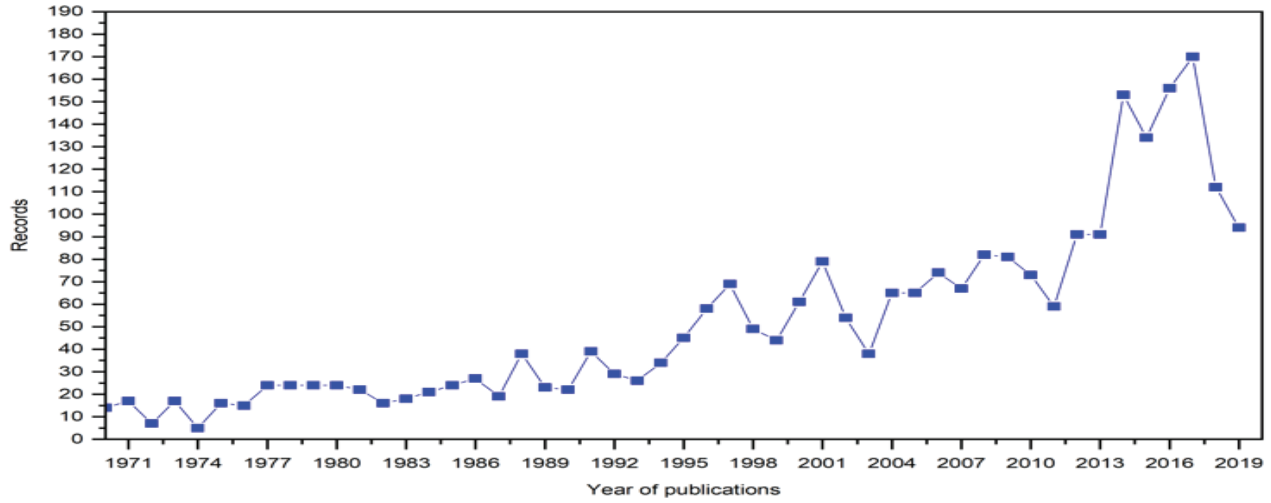

Figure-I: Trend of publications in polio research in the last 50 years.

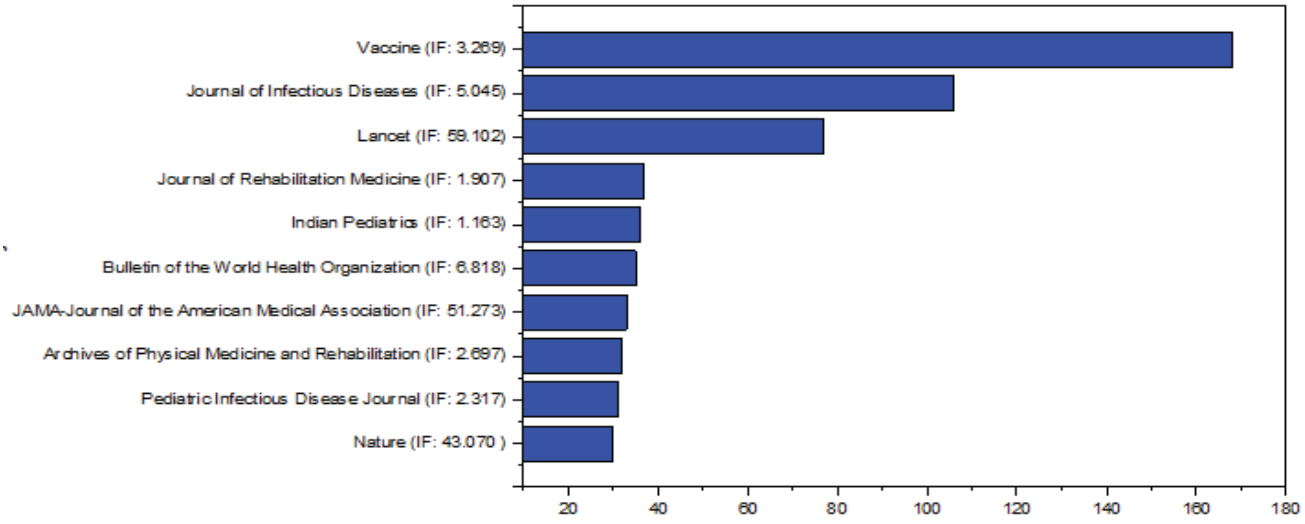

Figure-II: Top ten leading journals with the most number of publications. IF: Impact Factor.

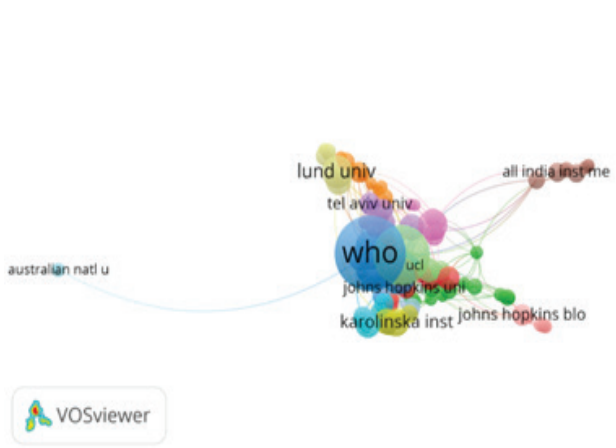

Figure-III: Co-authorship organizations network visualizations mapping.

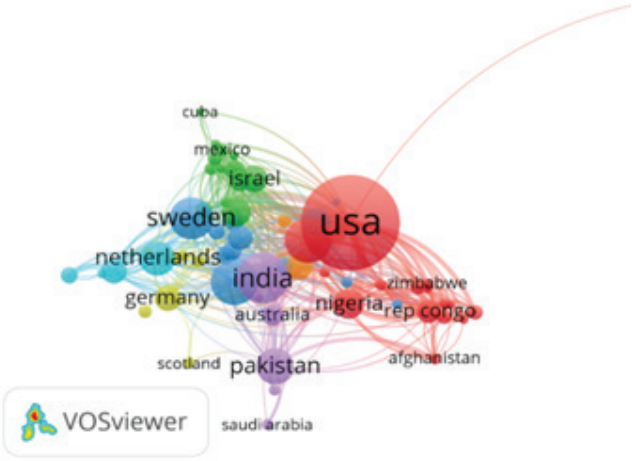

Figure-IV: Co-authorship countries network visualization mapping.

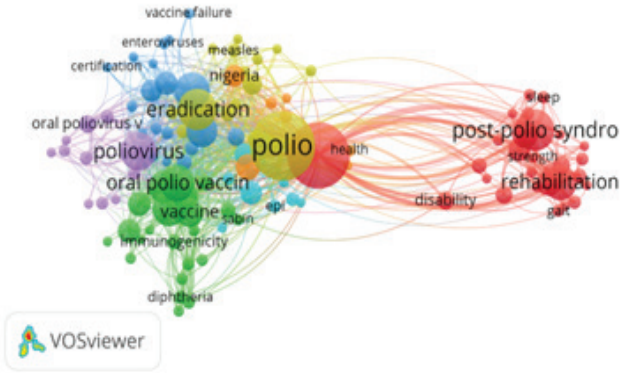

Figure-V: Co-occurrence author keywords network visualizations mapping.

3.9. Co-authorship organizations network visualization mapping. Of the 1917 organizations, only 143 met the threshold. The larger size of a node represents the highest number of publications, while the thicker line/link represents the stronger collaboration. The WHO was the leading organization with a total link strength (TLS) of 217, followed by CDC, USA (TLS=182), and BMGF (TLS=101), as shown in Figure III.

3.10. Co-authorship countries network visualization mapping. Of the 128 countries, only 61 met the threshold. A minimum number of documents of a country was set at 5. Based on TLS, the USA was the most influential country (TLS=457), followed by India (TLS=122), and England (TLS=153), as shown in Figure-IV.

3.11. Co-occurrence author keywords network visualization mapping. Of the total 2353 author keywords, only 110 met the threshold. Polio was the most dominant keyword, followed by poliomyelitis and post-polio syndrome (occurrence=216, total link strength=423), (occurrence=195, total link strength=317), and (occurrence=79, total link strength=89), respectively, as shown in Figure-V.

DISCUSSION

The current study is the first bibliometric analysis to systematically summarize the past fifty years of global trends in polio research indexed in the WoSCC database. This analysis may be worthwhile to keep the young researcher in the field abreast with classic knowledge. It may also be helpful for clinicians and researchers as well. In addition, the current analysis results can assist journal editors, reviewers, young researchers, experts of the field, organizations, and funding agencies in getting a clear direction on the problem [9].

Of the total included publications in this analysis, only 5 publications were cited more than 150 times. The citations frequency of the included publications was very low; however, the most cited papers were published in high IF journals like Nature, Orthopedics, Journal of Immunology, Science, Journal of Infectious Diseases, Proceedings of the National Academy of Sciences of the United States of America, PLoS Medicine, American Journal of Epidemiology, and Biotechnology. The IF is a frequently used indicator to evaluate the importance of a journal [10].

In total, more than 60% of publications were research articles, and only 3% were review articles. This represents the sensitivity and nature of studies on polio. Most of the top-cited publications were based on experimental designs because WHO and other funding agencies provided funds for the projects that come up with new results based on experimental work. In our study, the majority of publications were funded by United States Department of Health Human Services, BMGF, and WHO. The USA is ranked 5th among the top five leading donors to global health behind Sweden, Luxembourg, Norway, and Ireland [11].

Although polio has been a point of serious concern for decades, many studies were published in 2017, followed by 2016 and 2014. This might be due to the reason that, during this period, most of the research groups working on polio considered that new WPV cases were not being reported excepting from polio-endemic countries. However, in 2021, cVDPV is causing outbreaks in 18 African countries [12]. The Vaccine was the leading journal in polio research. In contrast, Nature has the lowest number of publications among the top ten journals. This depicts that most of the influential studies during the last 5 decades were related to vaccines, which shows that researchers focused on eradicating the disease through early immunization.

The USA was the leading country in polio research. This may be due to the availability of funding in the field of research [11]. The finding of our study is in line with other studies [13-18]. More research is needed to be done in this field, and researchers, especially from disease polio-endemic countries should be encouraged to carry on the research and share their findings in peer-reviewed journals.

LIMITATIONS

In the current study, a single database was utilized, which may alter the publication frequency and citations count. Furthermore, the search was limited to title field, publications year, and document types.

CONCLUSION

This bibliometric study presents global research trends in polio during the last five decades. It shows greater research output from high-income countries while technologically advanced and developed countries exhibit limited collaboration with developing countries. This reflects the state of affairs in other research fields. A better understanding of the clinical features, epidemiology, and polio-associated diseases is required in countries with high infection rates. Low- and middle-income countries need to be supported through funding and by collaborating with them to upgrade the technical skills of researchers to involve them in research activities.

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Author's Contribution:

Muhammad Khan: Conceived the idea, screened the articles, collected the data, and prepared the first draft.
Tauseef Ahmad: Conceived the idea, screened the articles, collected and analyzed the data, draw the table and figures, prepared the first draft of manuscript, critical review and proof-reading, and supervised the study. .
Muhammad Mumtaz Khan, Manal Abdulaziz Murad, Asmat Ali, Abdur Rehman: Helped in data collection and manuscript writing.
Mukhtiar Baig: Critical review and edited the manuscript.

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