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Maria Angélica Ramos da Silva






The impact of Zika virus on children's development: a review using bibliometric analysis

ABSTRACT: This bibliometric review aims to explore and discuss the scope and limitations of the literature addressing the consequences of Zika virus infection and its impact on child development. The objective is to comprehensively demonstrate the collaboration network among countries and institutions and track emerging trends. A systematic literature review was conducted using the Web of Science database, covering publications from 2016 to June 2022. The VOSviewer tool was employed for bibliometric analysis, examining co-authorship, keyword co-occurrence, and co-citation of journals, authors, and references in the literature. Data were obtained from 161 studies published across 44 categories, with pediatrics and clinical neurology as primary fields. Three main research trends were identified: one focusing on congenital Zika syndrome and its association with cerebral palsy and epilepsy, and the other trend examining the relationship between infection during pregnancy, geographic location, and the neurodevelopmental characteristics of affected children. Our study provides a comprehensive overview of the current state of Zika virus research, specifically regarding its effects on child development. The findings highlight global collaboration patterns and research institution affinities, with Brazil emerging as a leading contributor to the literature.

Keywords: bibliometric; congenital syndrome; microcephaly; neurodevelopment.

Zika vírus e o impacto no desenvolvimento infantil: uma revisão baseada em análise bibliométrica

RESUMO: O objetivo desta revisão bibliométrica foi explorar e discutir a amplitude e as limitações da literatura que aborda as consequências da infecção pelo vírus Zika e os danos ocasionados ao desenvolvimento infantil. O intuito foi demonstrar de forma abrangente a rede de colaboração entre países e instituições, além de rastrear tendências emergentes. Uma revisão sistemática da literatura foi realizada utilizando o banco de dados Web of Science, abrangendo publicações de 2016 a junho de 2022. A ferramenta VOSviewer foi empregada para análise bibliométrica, examinando a coautoria, coocorrência de palavras-chave e cocitação de periódicos, autores e referências na literatura.

-  Lívia Pereira Ferreira ^[1]
-  Shênia Santos Monteiro ^[2] *
-  Mikaelly Batista da Silva ^[3]
-  Juciano Gasparotto ^[4]
-  Matheus Augusto de Bittencuort Pasquali ^[5]

[1] liviapereiraferreira38@gmail.com
[2] shenia-monteiro@hotmail.com
[3] mikaelly.b66@gmail.com
[5] matheus.augusto@professor.ufcg.edu.br
Center for Technology and Natural Resources, Federal University of Campina Grande (UFCG), Campina Grande, Paraíba, Brazil

[4] juciano.gasparotto@gmail.com
Institute of Biomedical Sciences, Federal University of Alfenas (UNIFAL), Alfenas, Minas Gerais, Brazil

* Autor para correspondência.



Foram obtidos dados de 161 estudos publicados em 44 categorias diferentes, com pediatria e neurologia clínica como as principais áreas. Três principais tendências de pesquisa foram identificadas: uma destacando a síndrome congênita do Zika e a relação entre paralisia cerebral e epilepsia; as outras abordam a relação entre infecção durante a gravidez, localização geográfica e as características do neurodesenvolvimento das crianças afetadas pela infecção. Este estudo fornece uma visão abrangente do estado atual da pesquisa sobre o vírus Zika, especificamente em relação aos efeitos no desenvolvimento infantil. As informações obtidas neste estudo lançam luz sobre os padrões globais de colaboração e afinidade das instituições de pesquisa, especialmente no Brasil, que concentra o maior número de publicações.

Palavras-chave: bibliometria; microcefalia; neurodesenvolvimento; síndrome congênita.

1 Introduction

The Zika virus was first isolated in 1947 on the Entebbe Peninsula, Uganda. Over the next 60 years, it was confirmed in the equatorial regions of Africa and Asia, later spreading to Yap Island in 2007 and reaching Latin America in 2015 (Song *et al.*, 2017; Petersen *et al.*, 2016). Zika virus infection is primarily transmitted by *Aedes aegypti* and *Aedes albopictus* mosquitoes, although there are reports of perinatal and sexual transmission (Sun *et al.*, 2021).

An outbreak of Zika virus infections in Brazil captured global attention due to the suspected link between the virus and adverse pregnancy outcomes, including an increase in newborns with microcephaly. Studies have established a clear connection between congenital ZIKV infection and cases of microcephaly and neonatal neurological disorders, not only in Brazil but also in other countries and regions such as Colombia, French Polynesia, Panama, and Martinique (Cardoso *et al.*, 2015). However, it is crucial to understand further the primary clinical evidence regarding the developmental consequences for children affected by the Zika virus. This knowledge can enhance the database of information critical for diagnosing and monitoring children with congenital Zika virus syndrome. Bibliometric analysis is one method to systematically evaluate the scientific literature on Zika virus-related issues in children.

Bibliometric analysis is a statistical tool widely used to provide qualitative and quantitative data on high-impact publications within specific subjects (Wang; Maniruzzaman, 2022). Such research, constructed from bibliographic databases, can elucidate and disseminate global scientific literature patterns and trends across various scientific fields (Mörschbacher; Granada, 2022). Thus, bibliometric analysis is an effective methodology for accumulating additional evidence on the Zika virus and its impacts on child development, supporting future studies. Notably, no previous study has presented a bibliometric analysis focused on the developmental consequences and delays in children infected by the Zika virus.

Therefore, the purpose of this review was to examine the literature regarding the implications of Zika virus infection and its impact on child development. The goal was to present the latest research approaches and trends in this field, aiming to comprehensively illustrate the collaborative network among countries and prominent institutions. Additionally, this review seeks to offer a convenient and adaptable method for identifying and monitoring emerging trends, thereby aiding in the formulation of

public health policies and furthering research in areas with significant knowledge gaps and advances in clinical practices.

2 Methods

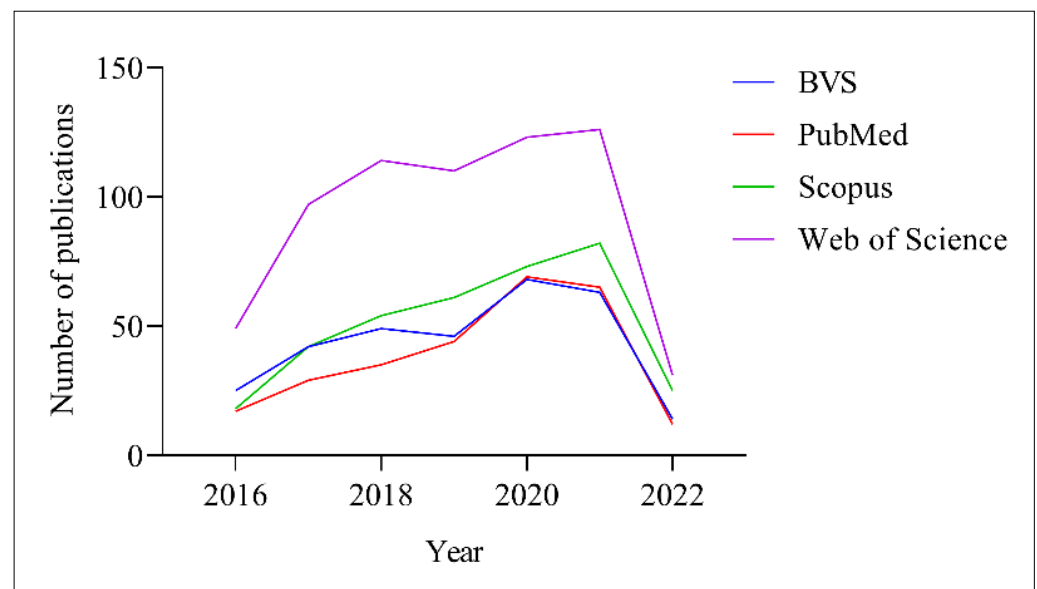
The Methods section describes the methodological approach used to conduct the study and data collection, providing essential details for the replication of the research.

2.1 Data source

The selection and refinement of data is a critical part of bibliometric research (Arora; Chakraborty, 2021). To choose the database, the terms "Zika" and "child development" were used as search topics in the Web of Science, Scopus, PubMed, and Virtual Health Library (BVS) databases. The number of publications in each database was considered when selecting the data source. Figure 1 shows that the Web of Science database has the largest collection of publications on the Zika virus and child development from January 2016 to June 2022. Furthermore, when analyzing the documents found in different databases, it was observed that only the Web of Science collection included all or most of the documents published in international journals compared to the other databases. Thus, it was concluded that documents collected from the Web of Science alone were sufficient to understand the current state of scientific research on the Zika virus and child development.

Figure 1 ▶

Evolution in the number of publications on the Zika virus indexed in different databases. Results of the search for documents on Zika and child development in the BVS, PubMed, Scopus, and Web of Science databases. Source: research data



The Web of Science has been extensively used as a database in various review studies and bibliographic analyses due to its status as one of the largest collections of scientific data (Humboldt-Dachroeden; Rubin; Frid-Nielsen, 2020; Wang et al., 2022; Zhao, 2022). This international, multidisciplinary source compiles scientific publications of significant impact, making it an essential database for bibliometric studies that provide indicators of scientific production (Ruiz-Fresneda et al., 2022). Consequently, the Web of Science was chosen for this study. Information on all authors and their affiliations,

abstracts, keywords, cited references, and names of institutions were collected from each publication, enabling an in-depth exploration of scientific knowledge about the Zika virus and child development.

2.2 Eligibility criteria and selection of studies

To search the Web of Science database, the terms "Zika" and "child development" were used, resulting in 650 publications. The terms were defined based on two factors: i) the increase in recent cases of Zika virus infection; ii) a preliminary search highlighting the main terms present in relevant scientific studies. No filters were applied to the search, and all results were evaluated, excluding studies that did not address the effect of Zika virus infection on child development. The titles, keywords, and abstracts of the publications were assessed, leading to the exclusion of 489 publications. Data were exported to EndNote (myendnoteweb.com) to check for duplicate references, with none found. The final sample comprised 161 publications from January 2016 to June 2022 concerning the effects of the Zika virus on child development.

2.3 Bibliometric analysis and the VOSviewer tool

Bibliometrics, initially applied in Information Sciences, involves analyses based on extraction techniques, classification, and evaluation of knowledge banks, enabling the creation of structural images and diverse syntheses of investigative domains (Wang *et al.*, 2022). Through qualitative and quantitative analysis of publications, bibliometric analysis can estimate contributions from a given field, discover boundaries, and predict emerging trends for a specific topic (Qin *et al.*, 2022). Given the challenge of grouping publications in bibliometric studies (Huang *et al.*, 2022), VOSviewer was selected as the main tool for visual analysis. VOSviewer creates bibliometric maps based on network data, plotting the network structure across clusters of similar data (Helha; Wang, 2022). To collect related information between authors, keywords, journals, and institutions, the VOSviewer¹ v.1.6.17 tool was used to analyze co-authorship, co-occurrence of keywords, and co-citation.

[1] VOSviewer. Available at: <https://www.vosviewer.com>

2.4 Co-citation analysis

Co-citation analysis visualizes the structure of the knowledge base and maps the interrelationships in the field of study by considering the most cited documents (Foroudi *et al.*, 2021). It is commonly used in bibliometric studies to identify the frequency of co-citation between any two authors; the higher the frequency, the closer their academic relationship (Zhao, 2022). In this study, we performed a co-citation analysis of journals, authors, and references related to Zika virus and child development. For the most cited journals and authors, the complete counting method was used, setting a minimum of 20 citations per author. Thus, out of 2913 authors, 39 were included in the analysis. For co-citation of references, a minimum of 13 citations per reference was established, resulting in 51 out of 3522 cited references being included. The co-citation network was constructed based on the strength of association, with a maximum of 1000 lines displaying the most consistent links between nodes.

2.5 Co-author analysis

Co-authorship analysis examines interactions between scholars within a research area, considering co-authorship as a formal form of intellectual collaboration. It is essential to understand author relationships and evaluate attributes such as affiliated institutions and countries (Donthu *et al.*, 2021). For this analysis, authors' affiliations were evaluated to understand the collaboration network between institutions, countries, and regions of researchers studying child development in the context of Zika virus infection. Documents with more than 25 affiliations were excluded, and a minimum of 5 documents per affiliation was set. Applying these criteria, 23 out of 374 organizations were selected. The collaboration network was constructed based on the strength of association, with a maximum of 1000 lines displaying the most consistent links between nodes.

2.6 Co-occurrence analysis

Co-occurrence analysis detects the co-occurrence of various information in articles (Zhao, 2022). Constructing keyword co-occurrence maps allows researchers to interpret high-future-trend topics within the search domain by examining citation numbers (Foroudi *et al.*, 2021). Unlike citation analysis, keyword co-occurrence analysis examines the actual content of publications, using words derived from "author's keywords" or extracted from "article titles," "abstracts," and "full text" when necessary (Donthu *et al.*, 2021).

A co-occurrence analysis of keywords was performed using the authors' keywords, employing the complete counting method. A minimum of 5 occurrences per keyword was set, resulting in 29 out of 538 keywords being selected. A keyword patch file was uploaded to merge synonyms, and the co-occurrence network was constructed based on the strength of association, with a maximum of 1000 lines displaying the most consistent links between nodes.

3 Results

In this section, we present the main quantitative and qualitative data collected from the literature, including publication trends, citation patterns, collaboration networks, and key research points related to the topic of interest. The evaluation of these results elucidates the existing body of knowledge and contributes to a deeper understanding of the field's evolution and direction.

3.1 Web of Science publication records

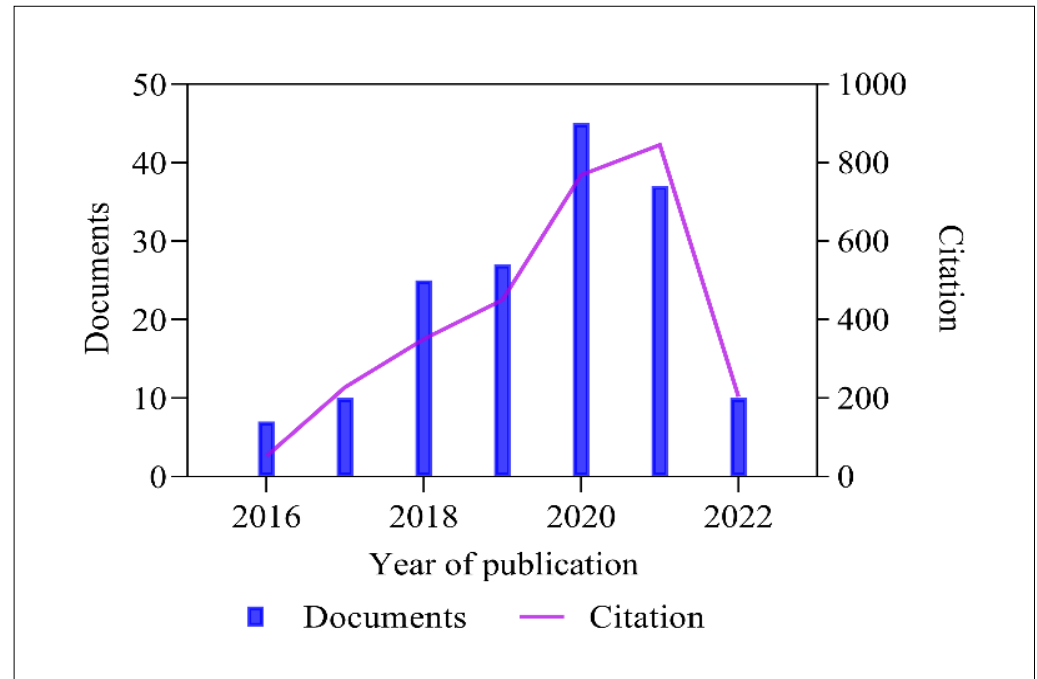
A total of 161 documents were retrieved, spanning the period from 2016 to 2022. These documents included 131 original articles (81.37%), 22 review articles (13.66%), 3 meeting abstracts (1.86%), 2 early access articles (1.24%), 2 conference articles (1.24%), and 1 letter (0.62%). The dataset, obtained from the Web of Science, encompassed publications across 44 different categories. The majority of these publications were in the Pediatrics category (31.88%), followed by Clinical Neurology (15.63%), Public Environmental Occupational Health (11.25%), Infectious Diseases (10.63%), General

Internal Medicine (7.50%), Tropical Medicine (7.50%), Oral Surgery Medicine of Dentistry (6.88%), Developmental Biology (5.00%), Immunology (5.00%), and Parasitology (5.00%).

Figure 2 illustrates the relationship between the number of publications and citations in the Web of Science database, focusing on the association between the Zika virus and child development outcomes from 2016 to 2020. During this period, an annual growth rate in publications was observed. However, from 2021 to June 2022, there was a decline in the number of publications, likely due to the heightened focus on the COVID-19 pandemic.

Figure 2 ▶

Production data and citation of Zika virus documents. Number of documents retrieved from the Web of Science database and the relationship with the number of citations from 2016 to June 2022. *Source: research data*



The number of records in the Web of Science displayed an exponential growth trend until 2020. From January 2021 to June 2022, the number of publication records decreased, possibly due to the COVID-19 pandemic. Despite this, the number of citations continued to grow annually, with a reduction noted only in 2022, likely reflecting the timing of the database query.

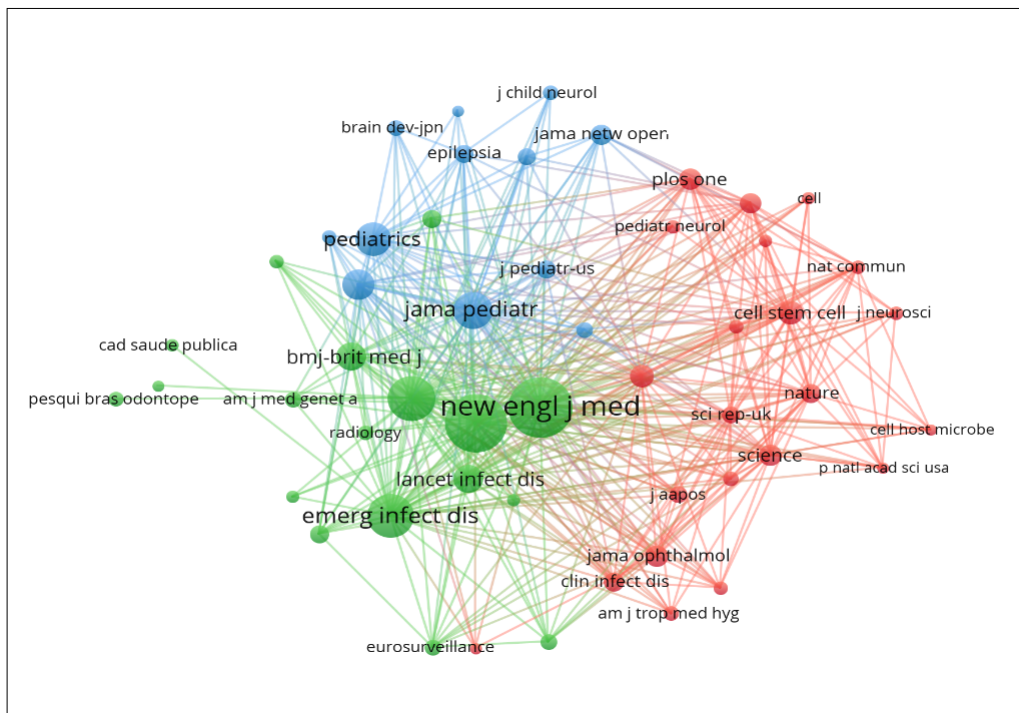
3.2 Distribution of cited journals

Figure 3 presents the co-citation network of journals with a minimum participation of 20 articles on the Zika virus and child development. The most-cited journals are represented by larger circles. The New England Journal of Medicine ranked first in the number of citations ($n = 290$), followed by Morbidity and Mortality Weekly Report (MMWR) ($n = 271$), Lancet ($n = 179$), Emerging Infectious Diseases Journal ($n = 174$), JAMA Pediatrics ($n = 131$), Pediatrics ($n = 114$), Science ($n = 58$), BMJ-British Medical Journal ($n = 88$), Developmental Medicine & Child Neurology ($n = 96$), and Cell Stem Cell ($n = 63$). Figure 3 also shows the formation of three clusters, as observed in the co-citation analysis between authors.

Figure 3 ►

Co-citation network between journals. Periodicals with a minimum productivity of 20 articles on Zika virus and child development from 2016 to 2022 were considered for the study. The size of the spheres reflects the co-citation frequency of the journals. Colors separate clusters by similarities.

Source: research data



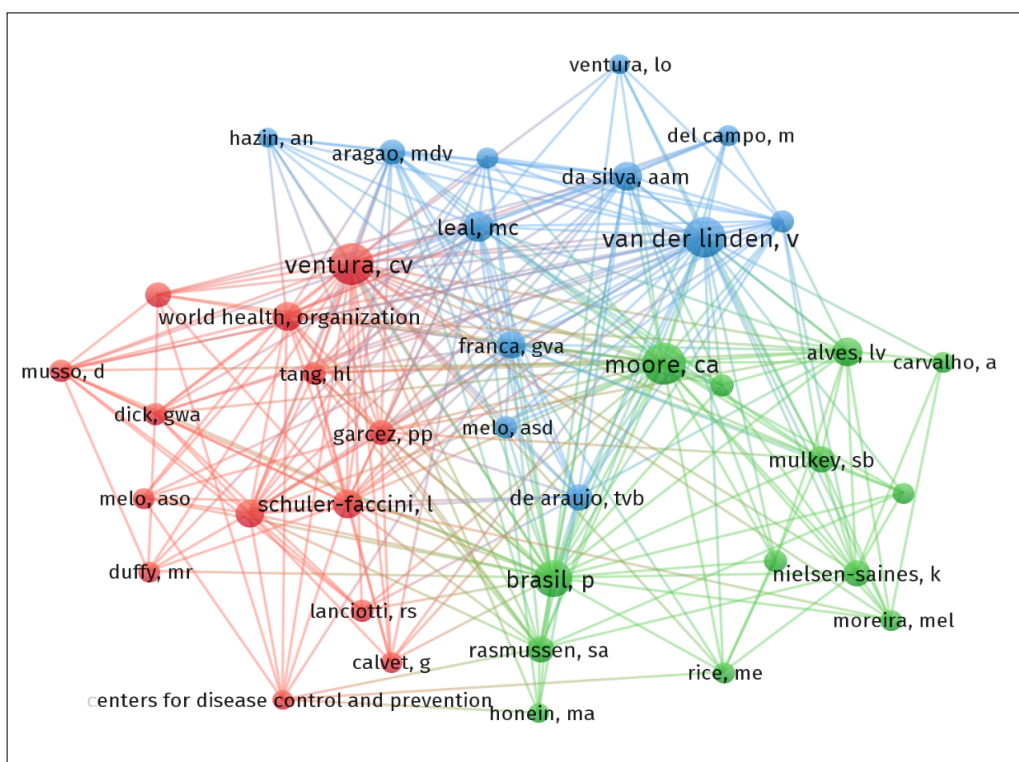
3.3 Author's co-citation

The authors who contributed to publications in the Web of Science database, each publishing five or more articles on the Zika virus and child development between 2016 and June 2022, were analyzed. Cynthia A. Moore had the largest number of documents, with 12 publications and a total of 940 citations. Figure 4 shows the co-citation network between the authors of the evaluated publications.

Figure 4 ►

Co-citation network of authors. Authors with a minimum of 20 citations in publications on the Zika virus and child development from 2016 to June 2022 were considered. The size of the spheres reflects the authors' co-citation frequency. Colors separate clusters by similarities, and lines indicate collaboration between authors.

Source: research data



Vanessa Van Der Linden, a prominent author on the subject, has significantly contributed to understanding the motor development outcomes of Zika virus infection in children, particularly through studies on abnormal postures and movements in children with congenital Zika virus syndrome (Van Der Linden *et al.*, 2020). She forms a cluster with researchers such as Mariana C. Leal, who examined the relationship between the Zika virus and dysphagia development in infants with microcephaly (Leal *et al.*, 2017). Cynthia A. Moore's comprehensive work on congenital Zika syndrome (Moore Moore *et al.*, 2017) provides critical insights for clinicians. In the same cluster, Patricia Brasil has studied the transmission of the Zika virus in children and its associated abnormalities (Brasil *et al.*, 2016; Brasil *et al.*, 2020).

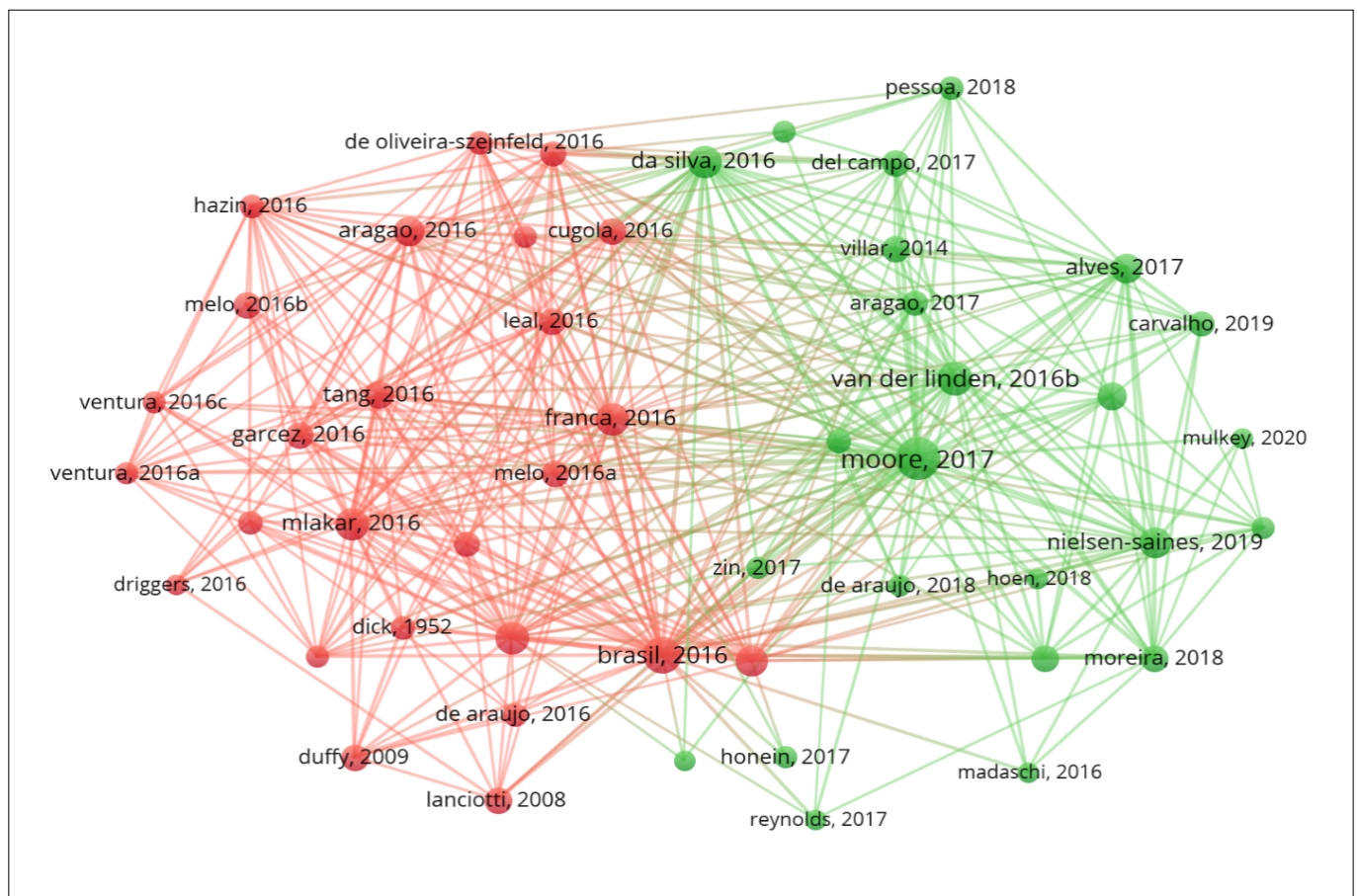
Figure 5 ▼

Most cited references in documents selected to study the Zika virus in child development. The size of the spheres reflects the citation frequency of the references. Colors separate clusters by similarities.

Source: research data

3.4 Co-citation of references

The 50 most-cited publications among the documents collected from the Web of Science were evaluated (Figure 5). Each publication was cited at least 13 times. The co-citation analysis revealed the formation of two clusters. The first cluster, comprising 27 references, includes articles addressing clinical manifestations of Zika virus disease in mothers and the repercussions of acute Zika virus infection in babies (Brasil *et al.*, 2016). This cluster primarily focuses on the association of infection during pregnancy with the Zika virus and its outcomes in children.



Cluster 2 delineates the spectrum of anomalies caused by Zika virus infection. Moore *et al.* (2017) characterized anomalies associated with congenital Zika syndrome,

providing valuable information for pediatric physicians tasked with evaluating and treating affected children and infants. This cluster reviews recent evidence to better characterize congenital Zika syndrome.

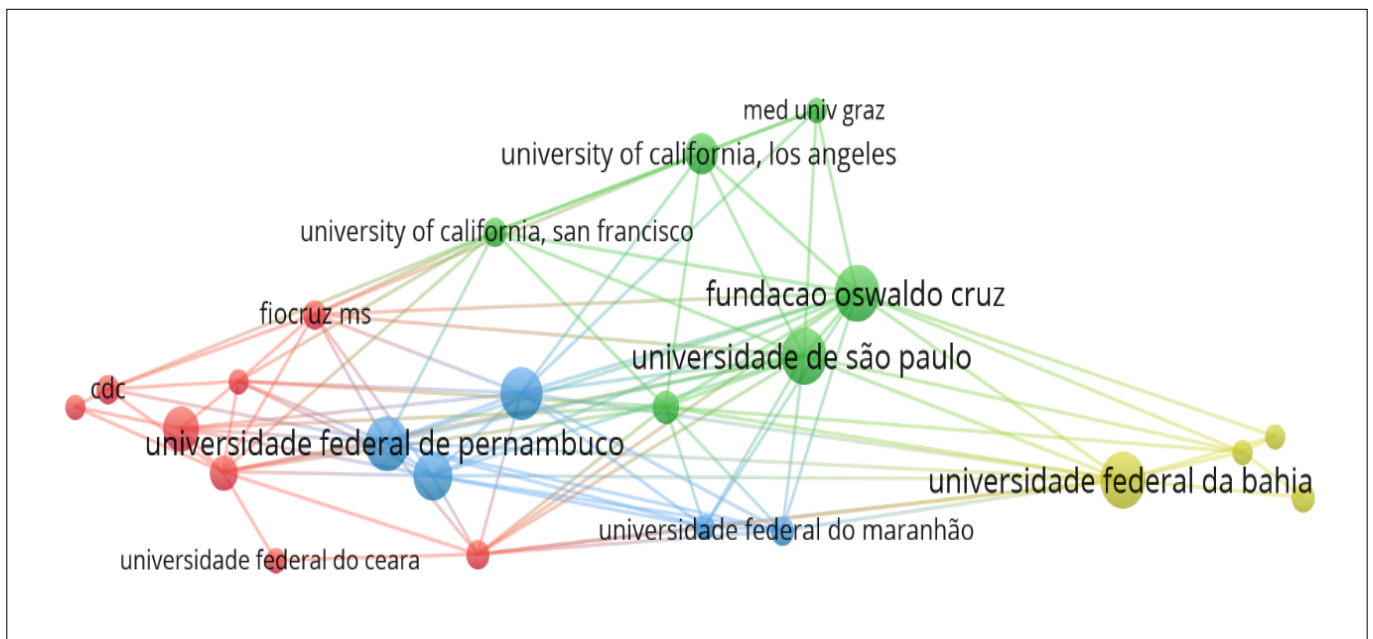
3.5 Top research institutions and countries

Figure 6 ▼

Collaboration network between research institutions. Institutions with a minimum of 5 documents were considered. The size of the spheres reflects the frequency of occurrence of the institutions. Colors separate clusters by similarities, and lines indicate collaboration between institutions. Source: research data

The 161 articles were authored by researchers affiliated with institutions in 39 countries/regions. Brazil published the largest number of studies (67.5%), followed by the United States (46.9%), England (14.4%), Colombia (5.6%), and Germany (4.4%). Brazil's significant contribution is linked to the scale of the recent outbreak, where 440,000-1,300,000 cases were reported (Wikan; Smith, 2016). Key contributors to this research are also found in the United States and England (total link strengths of 78 and 46, respectively).

The literature search identified 398 research institutions with relevant publications, 23 of which contributed at least five documents. The Oswaldo Cruz Foundation and the University of São Paulo each published 18 records, followed by the Federal University of Pernambuco ($n = 17$), Federal University of Bahia ($n = 17$), and London School of Hygiene & Tropical Medicine ($n = 16$). The collaboration network between these institutions is shown in Figure 6.



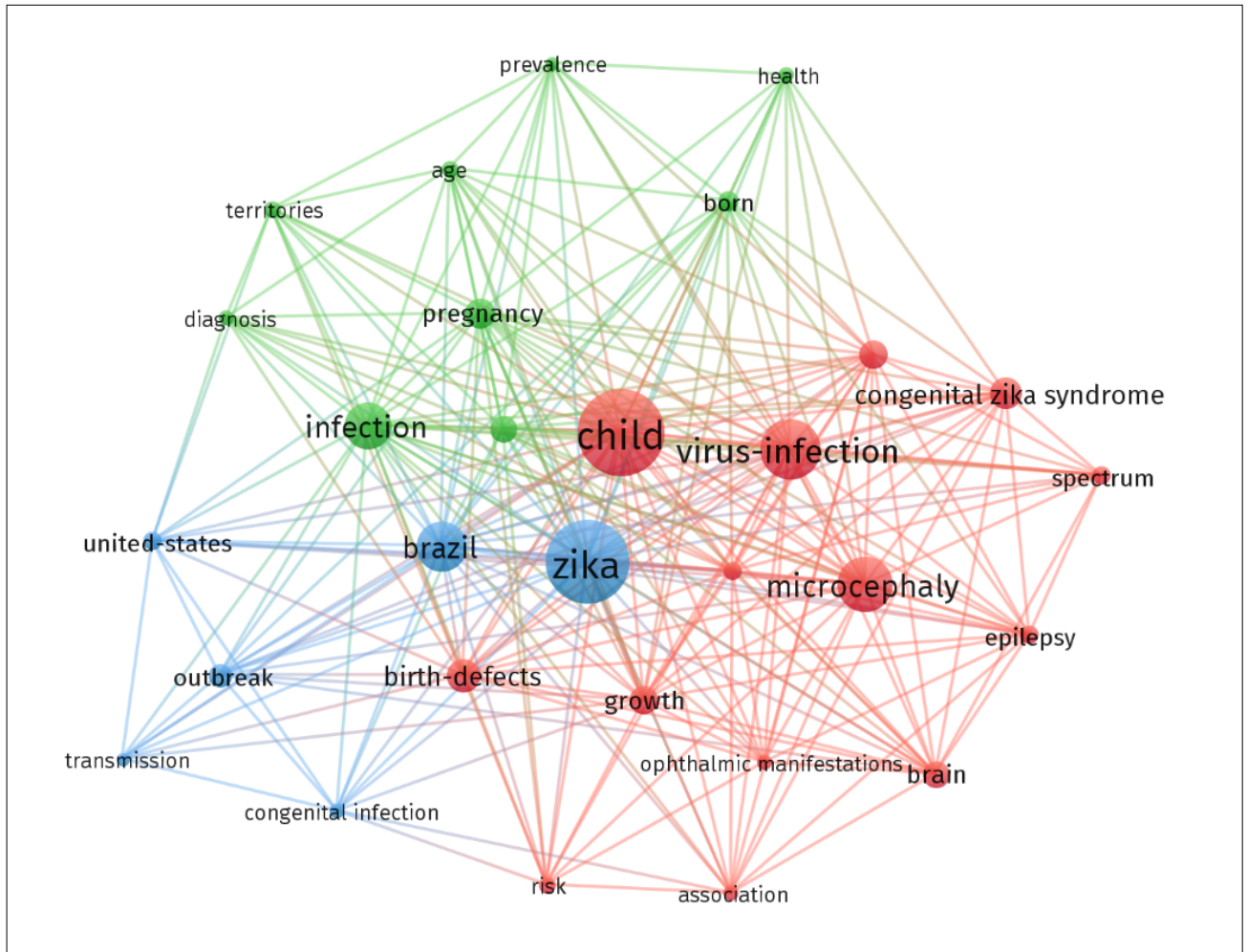
The Oswaldo Cruz Foundation is the largest contributor, with 413 citations. Researchers from this institution have primarily studied neurological outcomes and heterogeneous development in children with congenital Zika syndrome. The London School of Hygiene & Tropical Medicine, Federal University of Pernambuco, and University of São Paulo were key collaborators with total link strengths of 42, 41, and 41, respectively.

Figure 7 ▼

3.6 Top search terms

Author's keyword network. Authors with a minimum of 5 occurrences in articles between 2016 and June 2022 were considered. The size of the spheres reflects the occurrence of the word. Colors separate clusters by similarity. Source: research data

Among the 538 keywords provided by the authors of the 161 articles retrieved from the Web of Science, 29 keywords occurred more than five times and were used in our analysis, forming a co-occurrence network (Figure 7). The most frequently used keywords were “child” ($n = 84$), “Zika” ($n = 78$), “virus infection” ($n = 48$), and “microcephaly” ($n = 41$).



The keywords formed three clusters, identifying related topics according to link strength. The largest cluster, consisting of 14 keywords, focuses on anomalies caused by Zika virus infection in children, with “congenital Zika syndrome,” “cerebral palsy,” and “epilepsy” being prominent terms post-2019. The second cluster, with 9 keywords, highlights the relationship between geographic territory, the history of Zika virus infection in pregnant women, and neurodevelopmental outcomes in children, with “neurodevelopment” emerging as a key research trend post-2019. The third cluster explores the effects of virus transmission related to geographic location and the diagnosis of congenital infection.

4 Discussion

Several studies in the literature have elucidated the link between the Zika virus and Congenital Zika Syndrome (CZS). However, each new study raises additional questions, prompting further research across various medical specialties concerning the different organs and systems affected by the Zika virus.

In terms of bibliometric studies on the development of children diagnosed with Zika virus infection, our study offers comprehensive coverage of several journals indexed in the largest database, the Web of Science. This includes global geographic coverage and leading authors and research institutions contributing to the advancement of knowledge regarding the effects of Zika virus infection on child development. Additionally, the research conducted through the Web of Science enabled us to construct an overview of the current literature, highlighting the primary manifestations and clinical characteristics associated with congenital Zika virus syndrome.

From 2016 to June 2022, there has been a significant increase in studies addressing the Zika virus and its relationship with anomalous development in infected children. This surge can be attributed to the emergence of the first cases of microcephaly and the subsequent alarming outbreak in Brazil in 2016, which spurred the scientific community to seek answers regarding the damage caused to fetal development. However, the results indicate a decrease in publications on this topic until June 2022 (Figures 1 and 2), possibly due to the shift in focus towards the COVID-19 pandemic during its critical phases. Another potential reason for the decline in publications could be the budget cuts in Brazilian universities and public institutions, which impeded the progress of scientific research. Brazil, being the country with the highest number of studies and significant research institutions such as the Oswaldo Cruz Foundation, was particularly affected.

Despite the substantial body of research on Zika virus infection, much remains to be explored. Our study aids scientists in utilizing various strategies to improve diagnostic practices and follow-up on children's development, ultimately contributing to better overall quality of life for affected children and their families.

The analysis of the co-citation network of journals revealed the most influential journals in the medical field related to our topic, with the New England Journal of Medicine standing out as the leading international journal for Biomedical Science and Clinical Practice. Publications in high-impact journals underscore the importance of the topic, drawing attention to critical issues in the research domain (Kabyl *et al.*, 2022). Future research may likely focus on improving the quality of life for children diagnosed with Zika virus infection, considering factors such as geographic location and socioeconomic conditions.

In the author co-citation analysis, Cynthia A. Moore emerged as a leading researcher, with 12 publications and a total of 940 citations from 2016 to June 2022. Other prominent authors included Camila V. Ventura, Vanessa van der Linden, Patrícia Brasil, and Lavinia Schuler-Faccini. Their research primarily focused on the characterization and standardization of abnormalities in congenital Zika syndrome, as well as clinical and molecular aspects associated with neural development, ophthalmological disorders, and motor development in children with CZS.

Our analysis of the co-citation of references revealed the formation of two clusters: i) Clinical manifestations of Zika virus disease in mothers and the repercussions of acute Zika virus infection in babies. During pregnancy, several factors can cause damage to fetal development, such as infectious agents that can cross the placental barrier and

promote cytotoxicity, interrupt the cell cycle resulting in mitotic inhibition, and cause vascular lesions, which can induce an aggressive reparative response that hinders fetal and child neurodevelopment up to two years of age (Abtibol-Bernardino *et al.*, 2020; Rosa *et al.*, 2020). ii) The delineation of the entire spectrum of anomalies caused by Zika virus infection. CZS consists of a set of neurological changes in fetuses and live births resulting from exposure to the Zika virus in the prenatal phase (Quilião *et al.*, 2020; Pessoa *et al.*, 2018). These anomalies include: i) changes in cranial morphology with a partially collapsed skull; ii) brain anomalies followed by neurological sequelae including cognitive, sensory, and motor disabilities; iii) ocular anomalies followed by macular scarring and focal pigmentary retinal mottling; iv) congenital contractures (Moore *et al.*, 2017).

According to a study by Matiello *et al.* (2022), microcephaly is accompanied by specific brain lesions, such as subcortical calcifications. In severe cases of microcephaly, ocular changes, congenital contractures, hydrocephalus, muscle tone, postural changes, and severe early hypertonia (Moore *et al.*, 2017) are observed. These may occur due to programmed cell death of the nervous system during fetal development as a result of Zika virus replication (Quilião *et al.*, 2020).

Ophthalmological disorders in children affected by CZS occur due to neurosensory changes caused by calcifications, resulting in several sequelae and visual impairments. These impairments are due to damage to the optic nerve, chorioretinal and macular atrophy, abnormalities in the pigment epithelium, and macular pigment production, among other modifications (Oliveira *et al.*, 2020; Schuler-Faccini *et al.*, 2022). Costa *et al.* (2020) analyzed visual alterations in babies suspected of maternal Zika virus infection during the first trimester of pregnancy and those affected by microcephaly. The findings revealed that chorioretinal atrophy, focal spots of retinal pigment, and optic nerve abnormalities were significantly associated with Zika virus infection. Vision is crucial as it plays an essential role in communication and social integration during the development of motor and spatial skills. Therefore, early diagnosis, interventions, and visual stimulation enable these children to develop and explore their environment (Paixão *et al.*, 2022).

Despite extensive knowledge about the effects of congenital Zika virus syndrome on the central nervous system, further studies are needed to understand some phenotypic characteristics, especially the milder cases compared to more severe ones. Another gap exists in the understanding of children exposed to the Zika virus during the gestational period who do not develop CZS at birth but may have mild disorders during their first years of life (Calvet *et al.*, 2016).

Thus, the analyses presented in this article are of great importance to the scientific community as they offer an exhaustive overview of the current situation and future research directions regarding the effects of Zika virus infection on children's development. Additionally, our comprehensive study will foster beneficial collaborations between authors, institutions, and countries, significantly improving research in this field and facilitating the sharing of knowledge to enhance the monitoring and quality of life of these children.

4.1 Limitations

A certain set of limitations in bibliometric analyses must be considered when interpreting the results. These limitations include the research methodology, where only the Web of Science database was used in the search. Therefore, publications that were not indexed on the Web of Science could not be examined and analyzed. However, 10% of the

documents analyzed were manually evaluated, which shows that the method used in the study is valid and that the results obtained are accurate. Despite the inevitable limitations of the study, we believe that the results presented here can serve as a basis for future research and promote a valid discussion of the scientific literature on the development of children infected with the Zika virus.

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5 Conclusions

The scientific literature on the outcomes of Zika virus infection on children's development began in 2016 and has grown rapidly following the outbreak in Brazil. By reviewing publications over more than five years, this bibliometric analysis provided insights into collaboration patterns and research hot spots. The co-authorship analysis revealed that only 23 of the 374 authors had five or more publications on the subject, indicating high fragmentation at both individual and institutional levels. Brazil is a hegemon in scientific production on this subject, contributing 67.5% of the articles, reflecting the significant outbreak in Brazil that necessitated research in this area.

Future perspectives indicate a trend toward studying anomalies related to Zika virus infection. There is a need for more studies that monitor the growth and development of affected children, contributing to new interventions and tracking the progression of the infection and its clinical manifestations. This will aid in updating health professionals and providing guidelines on how to monitor and treat these children long-term. Additionally, it highlights the need for improvements in public policies and management strategies for this infection. These findings allow the scientific community to identify existing research gaps regarding the effects of Zika virus infection on children's development, making it possible to pinpoint emerging themes and frontiers that can guide future research.

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Conflict of interests

The authors declare no conflict of interest.

Contributions to the article

FERREIRA, L. P.; PASQUALI, M. A. B.: conception or design of the study/research; data analysis and/or interpretation. **MONTEIRO, S. S.; SILVA, M. B.:** data analysis and/or interpretation. **GASPAROTTO, J.:** final review with critical and intellectual participation in the manuscript. All authors contributed to the writing, discussion, reading, and approval of the final version of the article.

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