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Research trends on Bovine Respiratory Disease Complex (BRDC): A bibliometric analysis

Norah Alquaymi[1], Sarah M.A. Abusalab[2], Hussein Babiker[1], Mohamed Marzok[1*]

[1]*Department of Clinical Sciences, College of Veterinary Medicine, King Faisal University, Al-Ahsa, Saudi Arabia.*
[2]*Department of Microbiology, College of Veterinary Medicine, King Faisal University, Al-Ahsa, Saudi Arabia.*

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*Correspondence:

Corresponding author: Mohamed Marzok
E-mail address: mmarzok@kfu.edu.sa

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ABSTRACT

Bovine respiratory disease complex (BRDC) is a global multifactorial infectious disease of cattle. An essential technique for examining articles and other publications in literature is bibliometric analysis. By May 2025, we conducted quantitative research on BRDC. The Web of Science database (WOS) provided information about the disease. The VOSviewer software was used to set statistical data for each item under study, with an emphasis on the top ten outcomes for each item. After application of inclusion and exclusion criteria, 3,678 papers were included in the review. The findings showed that author Confer, Anthony had the most published articles (67, 1.82%), with the most recent publications coming out in 2024 (209, 5.68%). The USA was the leading country in publications (1439, 39.12%), and the top funding agency was the US Department of Agriculture (161, 4.37%). On the institutional front, the United States Department of Agriculture (USDA) led the way with 216 publications (5.87%). However, the least productive institute was Iowa State University (96, 2.61%). The majority of papers (3542, 96.30%) were in English, while Veterinary Sciences had the most publications in WOS categories (1868, 50.78%). The most prevalent type was research papers (3106, 84.44%). According to the bibliometric analysis, Elsevier was the primary publisher (893, 24.27%). The bibliometric analysis's findings show that there are an increasing number of studies on BRDC in cattle, which is concerning because the illness is alarmingly reemerging. The findings can aid in determining potential future strategies for its control and prevention.

Introduction

Bovine respiratory disease complex (BRDC) represents a significant challenge within the cattle industry, characterized by a multifaceted etiology involving various pathogens and complex immunological responses. The literature on this topic has evolved to address not only the economic impact of BRDC but also the underlying biological mechanisms that contribute to its prevalence and severity (Neibergs *et al*., 2014).

The critical role of genetic factors in the immune response to BRDC pathogens, emphasizing that some cattle exhibit greater resistance to the disease (Gershwin *et al*., 2015; Neibergs *et al*., 2014). Recently, it has been found that the genetic recombination analyses of BPIV-3 provided evidence for homologous recombination of bovine origin (Xu *et al*., 2024). Moreover, the molecular techniques used to investigate the microbiome's role in BRDC, revealing significant differences in microbial diversity between healthy and affected animals (Abrams, 2019).

It has been indicated that the immune response to Mycoplasma bovis as a cause of BRDC is distinct from that seen in murine models, with a complex interplay between host and pathogen factors complicating the identification of protective immune mechanisms (Ellis, 2001). It has been evidenced that nitric oxide may protect against the development of BRDC by limiting deleterious inflammation while simultaneously increasing TLR4 expression and enhancing the ability of the host to detect and respond to bacterial pathogens (Sheridan *et al*., 2016).

The economic implications of BRDC were further examined and the efficacy of viral and bacterial vaccines in feedlot cattle has been assessed (O'Connor *et al*., 2018). Their systematic review highlighted the importance of vaccination as a preventive strategy against BRDC, particularly in light of increasing concerns regarding antibiotic use in the beef industry.

Control and prevention of the disease depends on rapid diagnosis. For early diagnosis of BRDC, several biomarkers have been found eligible (Guo *et al*., 2021; Li *et al*., 2022). Vaccination program was found highly effective to lower the prevalence of the disease (Theurer *et al*., 2015). Non-specific protection from respiratory tract infections in cattle generated by intranasal administration of an innate immune stimulant has been documented (Wheat *et al*., 2020).

A statistical method for assessing research production for a particular scientific trend is called bibliometric analysis (Drijvers *et al*., 2020). One definition of "bibliometrics" is a statement that can be used in place of statistical bibliography (Pritchard, 1969). To create descriptive guidelines for scientific literature regarding essential research papers in a certain topic worldwide, bibliometric analysis was utilized. It incorporates a variety of assessment bases, offering information about the state of affairs at the moment, potential future results, and the consequences of the fields under study (Hsu *et al*., 2020). It might be beneficial to flare up to the point where a research field is present by concentrating on these words. Various descriptive items, such handling particular study fields, authors' and co-authors' contributions, veterinary journals (Pelzer and Wiese, 2003; Crawley-Low, 2006; Krauskopf *et al*., 2017; Schoenfeld-Tacher and M. Alpi, 2021), collaborative and interdisciplinary publications, and universities, are categorized and examined at the literature level. In scientific study, bibliometric analysis comes in a variety of forms. The most popular techniques include citation, co-citation, co-occurrence, bibliographic coupling, and co-authorship analyses (Van Eck and Waltman, 2014). Despite the fact that bovine BRDC has drawn attention from all around the world, no bibliometric analysis has been conducted recently to describe the dynamics and dispersion of this illness. In order to emphasize the veterinary and zoonotic significance of BRDC, the current study set out to give a bibliometric analysis of research works conducted over the past 20 years.

Materials and methods

Plan of search and data source prior to the analysis and visualization

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process, the data was first gathered by locating the databases, selecting suitable search strategies, retrieving the data, and cleaning the data. The Web of Science (WoS) database searched for papers on bovine respiratory disease complex (BRDC) research up until May 1st, 2025, for the current bibliometric study. The following are the primary words for BRDC found in the literature: "Cattle" and "Bovine" "Respiratory Disease Complex". The terms "Mannheima haemolytica" and "Shipping fever" were also used. The WoS topic field, which contained titles, abstract, and author keywords, was used to conduct the search. In order to prevent prejudice brought on by daily database updates, the search was also finished in a single day. The WoS extraction tool was used to extract raw data in BibTeX and txt formats. The extraction procedure contained information fields about authors, affiliations, authors' countries of publishing, citation subjects, WOS categories, types of articles, languages, research areas, funding agencies, publishers, journals, and years of publication.

Selection criteria

All publications on BRDC were included in this bibliometric analysis except for biographies, corrections, and retracted publications.

Statistical analysis

Authors, affiliations, published nations, citation themes, WOS categories, publication type, languages, research areas, funding agencies, publishers, journals, and publishing year were all included in the search results. Using specialized software (VOSviewer, version 1.6.14), the correlations between the most productive nations, research institutes, and commonly used terms were examined. Co-citation, coupling institution, and coupling documents. Additionally, social network maps with nodes and links for nations, organizations, and keywords were created, along with cluster analysis (Mulet-Forteza *et al*., 2019). In accordance with the number of studies included and the resulting analysis results, the minimum frequency of keyword occurrence in the publications was established at two or four times, respectively. A map's various nodes stand for various things, such as a nation, organization, or keyword. The number of publications or frequencies is reflected in the size of the nodes; the larger the node, the higher the number of publications or frequencies (Liang *et al*., 2017). Additionally, the relationships between co-occurrence, co-citation, and collaboration are represented by the link between nodes. Various clusters are represented by the colors of the lines and nodes (Gao *et al*., 2019).

Results

A comprehensive collection of 3,678 scholarly works concerning BRDC has been compiled. Among these contributions, the ten authors who have published the most are notably significant are presented in Table 1: Confer A leads with an impressive total of 67 papers, accounting for 1.82% of the overall contributions. While the lest contribution was presented by Step DL (34, 0.92%). The intricate co-authorship networks at the authorial level are organized by VOSviewer, illustrating 3,678 publications on BRDC and their broader implications in global research, visually represented in Figure 1.

Examining the publication years reveals that the last decade has witnessed a marked surge in interest regarding BRDC. Publication statistics indicate that 209 papers were released in 2024 (5.68%), with preceding notable years including 168 publications in 2021 (4.56%), 161 in 2022 (4.37%), and 158 in 2020 (4.29%), among others. The span from 2014 to 2023 also contributes to notable counts of publications, highlighting the growing body of knowledge in this area (Table 1).

On the institutional front, the United States Department of Agriculture (USDA) led the way with 216 publications (5.87%). However, the least productive institute was Iowa State University (96, 2.61%). A geographical perspective reveals that the USA stands as the frontrunner for publication numbers, with a staggering 1,439contributions (39.12%), as highlighted in Table 1. Regarding the funding agency, United States Department of Agriculture was in the top, but the National Institute of Food Agriculture was the least (Table 2). When considering language demographics, the majority of publications were recorded in English (3,542, 96.30%), with a smaller number in Turkish (4, 0.10%).

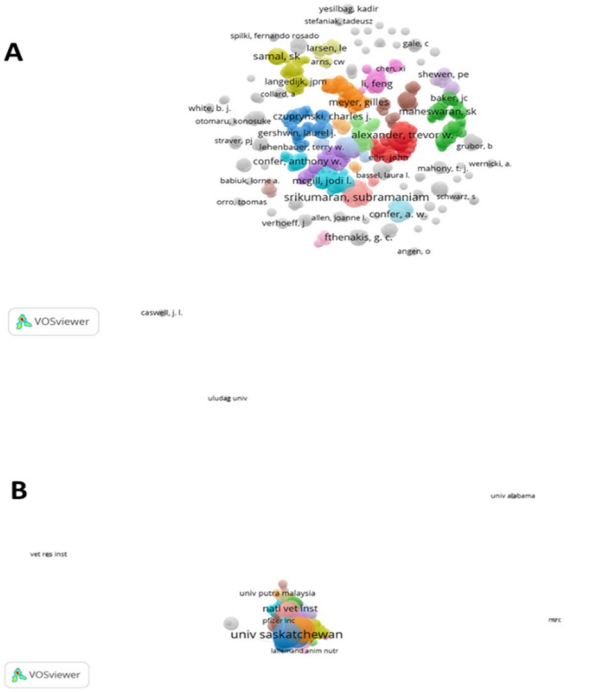

Figure 1. Co-author to author for studies on BRDC with 77 clusters the largest has 41 items (A) and Co-author organization with 23 clusters the largest has 30 items (B).

Categorizing the publications according to Web of Science (WOS) classifications, the leading area was veterinary sciences, comprising 1,868articles (50.78%), followed by microbiology with 573 (15.57%) and agriculture dairy animal science with 418 (11.36%). Additional categories include immunology and virology. However, the least category was the Medicine Research Experimental (Table 3). The citation topics, detailed in Table 4, exhibit the most frequently cited publications, with associated networks visible in Figures 2-4, displaying the sources and authors contributing to these citations.

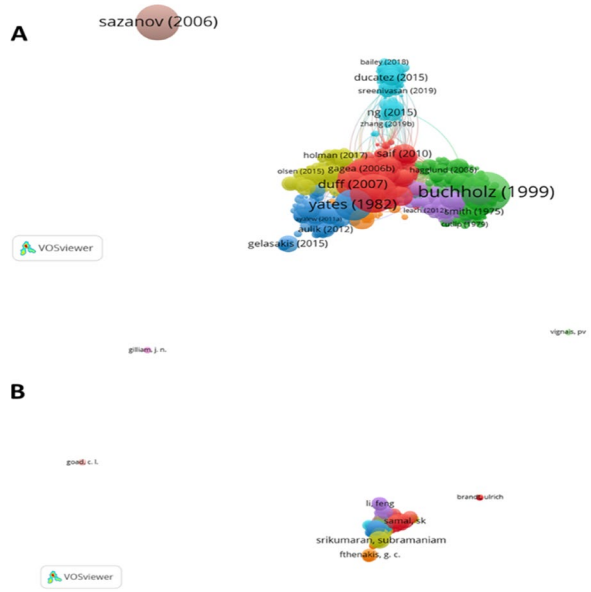

Figure 2. Citation to document for studies on BRDC with 8 clusters the largest has 220 items (A) and Citation to authors with 11 clusters the largest has 136 items (B).

Table 1. The top-ten most productive authors, publication years, affiliations and countries regarding bovine respiratory disease complex (BRDC).

Researcher Profiles	Count	
Confer, Anthony	67	1.82
Srikumaran, Subramaniam	46	1.25
Woolums, Amelia	46	1.25
Gershwin, Laurel	43	1.17
White, Brad	42	1.14
Alexander, Trevor W.	41	1.11
Briggs, Robert E.	39	1.06
Fthenakis, G. C.	38	1.03
Timsit, E.	37	1.01
McAllister, Tim A	37	1.01
Inzana, Thomas J.	36	0.98
Step, D. L.	34	0.92
Publication Years	**Count**	
2024	209	5.68
2021	168	4.57
2022	161	4.38
2020	158	4.30
2023	149	4.05
2019	145	3.94
2018	142	3.86
2016	141	3.83
2017	140	3.81
2015	126	3.43
2014	114	3.10
Affiliations	**Count**	**%**
United States Department of Agriculture USDA	216	5.87
University of Saskatchewan	156	4.24
Kansas State University	123	3.34
Oklahoma State University Stillwater	119	3.23
Oklahoma State University System	119	3.23
USDA Agricultural Research Service	114	3.09
University of California System	111	3.01
University of Guelph	100	2.71
Texas A M University System	98	2.66
Iowa State University	96	2.61
Countries/Regions	**Count**	
USA	1439	39.12
Canada	417	11.33
England	234	6.36
Germany	195	5.3
China	188	5.11
France	167	4.54
Netherlands	133	3.61
Brazil	126	3.42
Italy	123	3.34
Japan	112	3.04

Analysis of publication types reveals that research articles dominate the field with 3,106 entries (84.44%). Other forms included review articles (241, 6.55%), proceeding paper (112., 3.04%), meeting abstracts (96, 2.61%), note (34, 0.92%), Book Chapters (27, 0.73%), editorial material (16, 0.43%) and letters (16, 0.43%). Finally, the leading journals publishing research on BRDC encompass Veterinary Microbiology (149, 4.05%), while the least was Journal of Dairy Science (Table 5).

Table 2. The top-ten most funding Agencies regarding bovine respiratory disease complex (BRDC).

Funding Agencies	Count	
United States Department of Agriculture (USDA)	161	4.38
United States Department of Health Human Services	161	4.38
National Institutes of Health (NIH USA)	156	4.24
Uk Research Innovation	74	2.01
National Natural Science Foundation of China	59	1.60
Natural Sciences and Engineering Research Council of Canada	53	1.44
Biotechnology and Biological Sciences Research Council	50	1.36
NIH National Institute of Allergy Infectious Diseases	46	1.25
Conselho Nacional de Desenvolvimento Sientifico e Tecnologico	42	1.14
National Institute of Food Agriculture	37	1.01

Table 3. The top-ten most of web of science categories regarding bovine respiratory disease complex (BRDC).

Web of Science Categories	Count	
Veterinary Sciences	1868	50.78
Microbiology	573	15.57
Agriculture Dairy Animal Science	418	11.36
Immunology	388	10.54
Virology	204	5.54
Biochemistry Molecular Biology	188	5.11
Infectious Diseases	146	3.96
Biotechnology Applied Microbiology	131	3.56
Multidisciplinary Sciences	121	3.28
Medicine Research Experimental	103	2.8

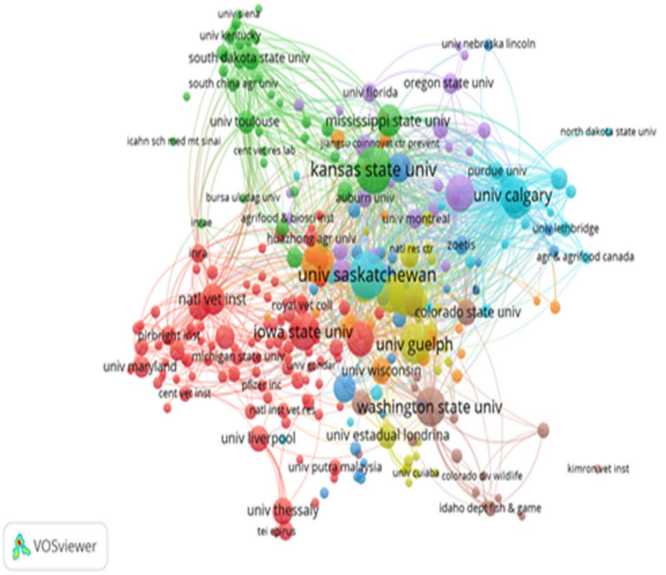

Figure 3. Citation to organization for studies on BRDC with 8 clusters the largest has 104 items.

To further explore the topic, a co-occurrence analysis was performed to ascertain focal themes and trending keywords in the realm of BRDC. The keywords that appeared at least five times were selected, with their occurrences mapped out in Figure 5. The VOSviewer network illustrates the frequency of each keyword, where the size of the nodes represents the number of occurrences, and the connecting lines highlight co-occurrences within studies. Additionally, bibliographic coupling information is visually represented in Figure 6, detailing the connections among documents, sources, authors, and institutions in this active field of research.

Figure 4. Citation to country for BRDC with 4 clusters the largest has 21items.

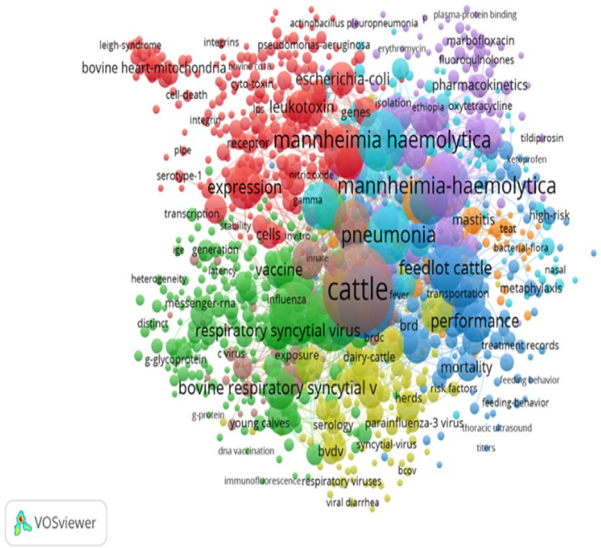

Figure 5. Co-occurrence with all keywords for studies on BRDC with 8 clusters the largest has 224 items.

Table 4. The top-ten most cited articles regarding bovine respiratory disease complex (BRDC).

Title	Authors	Source Title	Publication Year	Volume	Issue	Total Citations	Average per Year
Application of acute phase protein measurements in veterinary clinical chemistry	Petersen *et al*.	Veterinary Research	2004	35	2	769	34.95
Crystal structure of mitochondrial respiratory membrane protein complex II	Sun *et al*.	Cell	2005	121	7	676	32.19
Structure of the hydrophilic domain of respiratory complex I from Thermus thermophilus	Sazanov and Hinchliffe	Science	2006	311	5766	659	32.95
ROS and redox signaling in myocardial ischemia-reperfusion injury and cardioprotection	Cadenas	Free Radical Biology and Medicine	2018	117		613	76.63
Biofilm bacteria: formation and comparative susceptibility to antibiotics	Olson *et al*.	Canadian Journal of Veterinary Research-	2002	66	2	552	23
A review of infectious bovine-rhinotracheitis, shipping fever pneumonia and viral-bacterial synergism in respiratory-disease of cattle	Yates	Canadian Journal of Comparative Medicine	1982	46	3	505	11.48
Clinical evaluation of postpartum vaginal mucus reflects uterine bacterial infection and the immune response in cattle	Williams *et al*.	Theriogenology	2005	63	1	455	21.67
Acute-phase proteins: As diagnostic tool	Jain *et al*.	Journal of Pharmacy and Bioallied Sciences	2011	3	1	449	29.93
Respiratory Syncytial Virus-A Comprehensive Review	Borchers *et al*.	Clinical Reviews in Allergy & Immunology	2013	45	3	447	34.38
Cyclic AMP Produced inside Mitochondria Regulates Oxidative Phosphorylation	Acin-Perez *et al*.	Cell Metabolism	2009	9	3	396	23.29

Table 5. The top-ten most journals regarding bovine respiratory disease complex (BRDC).

Publication Titles	Count	
Veterinary Microbiology	149	4.05
American Journal of Veterinary Research	144	3.92
Journal of Animal Science	119	3.24
Veterinary Immunology and Immunopathology	81	2.20
Veterinary Record	69	1.88
Plos One	65	1.77
Vaccine	62	1.69
Frontiers in Veterinary Science	57	1.55
Journal of Veterinary Diagnostic Investigation	56	1.52
Journal of Dairy Science	55	1.50

Discussion

In the present study, an analysis of the publications conducted on BRDC. Confer A leads with an impressive total of 67 papers, accounting for 1.82% of the overall contributions. Confer published 237 articles overall, concentrating on BRDC. Confer has an H index of 43 with a total of 6796 citations. Nevertheless, rather than identifying the authors' intellectual structure, this kind of metric analysis was used to identify the social structure (Lu and Wolfram, 2012). Co-citation analysis, on the other hand, shows the co-cited articles as theme clusters, where the shared references between two publications stay the same throughout time (Jarneving, 2005; Lu and Wolfram, 2012).

In regard to the publication time, 209 papers were released in 2024 (5.68%), with preceding notable years including 168 publications in 2021. The span from 2014 to 2023 also contributes notable counts of publications. This finding might reflect the disease's widespread attention. Globally, attitudes regarding animal sciences and diseases have generally improved over time (Pifer *et al*., 1994) . Maybe every research gate opens

new possibilities for additional gates, such as continuousness for presumptive research ideas. This topic is no exception, as research on BRDC is still prioritized due to its significance for the economy. Such attention may be prompted by a number of circumstances, including environmental changes that coincide with the resurgence of BRDC. As a result, there has been a recent increase in interest worldwide in the clinical assessment and treatment of BRDC (Booker, 2020; Buczinski and Pardon, 2020; Wennekamp *et al*., 2022; Kamel *et al*., 2024).

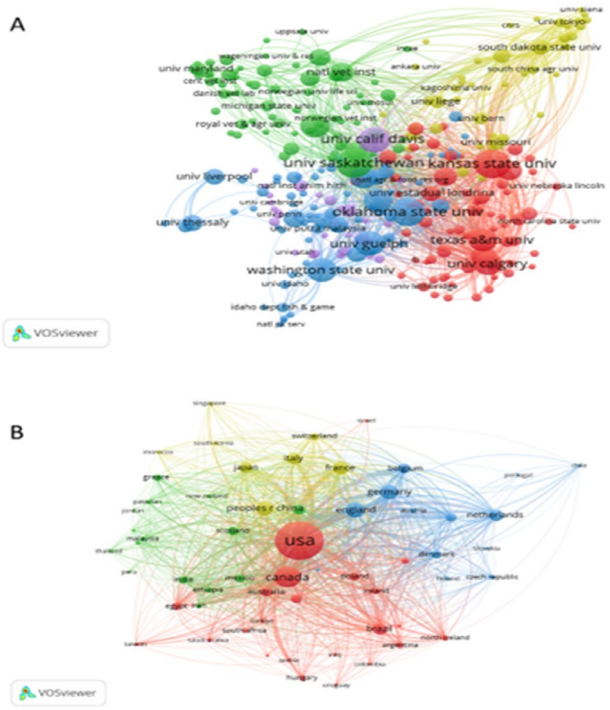

Figure 6. Bibliographic coupling to organization for studies on BRDC with 5 clusters the largest has 74 items (A) and bibliographic coupling to country with 4 clusters the largest has 23 items (B).

In the majority of articles that are available, institutions play a significant role. The main institutions involved in the current study's research on BRDC were the US Department of Agriculture. These results might be a reflection of the growing need for more research on these illnesses. It's interesting to note that funding organizations promote research initiatives (Gläser and Velarde, 2018). In keeping with the general description of the research contribution on BRDC, the United States, Canada, and England had the most publications overall. This result can indicate that funding organizations and institutes are interested in studying these subjects in order to address a number of questions about this problem. The final number of papers on BRDC may be influenced by many factors as risk factors, distribution and effect of treatment (Kamel *et al*., 2024).

The WoS Core collection was chosen for this study due to its systematic approach to gathering and assessing scholarly publications, which is regarded as optimal for in-depth bibliometric analysis. Scholars can objectively assess the success of publications in terms of scope and citation attributes thanks to this methodology. Over 252 subject categories in the arts, humanities, social sciences, and sciences are included in WoS. The category with the most articles in the current study was Veterinary Sciences (1868, 50.78%). Each journal is assigned to one or more topic groups in order to carry out this system. However, overlapping coverage of the categories may arise because it is frequently challenging to designate a journal to a single group. All of the subject categories allocated to the parent journal are sent down to each published item (Birkle *et al*., 2020).

In the present study, citation analysis has been conducted and showed the importance of the studies on BRDC. The goal of citation analysis is to quantify the impact of pertinent scientific research units, including authors, journals, and institutions (Hallinger and Kovačević, 2021). More citations, which are regarded as the most important indicator of efficacy, rank, and quality, are anticipated for these research groups (Donthu *et al*., 2021).Co-citation analysis was first used by Henry Small to identify an institution's strengths and flaws (Surwase *et al*., 2011). Additionally, a strong co-citation relationship is indicated by co-citation analysis, which displays whether the two research units appear together in the bibliography (Van Eck and Waltman, 2014). Furthermore, co-occurrence analysis visualizes concepts as a network and highlights concepts that are frequently shared in abstracts, titles, or even keywords of publications based on thematic clusters formed by the relationships between these concepts (Donthu *et al*., 2021). Additionally, co-authorship analysis was used to display social partnerships in a field study (Rousseau *et al*., 2018).

In terms of publishing type, research articles were the most common format. This appears to be very similar to what scholars in other disciplines of study are aware of. Reviews are typically less detailed and comprehensive than research papers. Although a review paper is not always available, a research paper is typically peer evaluated. Review articles tend to be less formal than research pieces (Booth *et al*., 2003; Ömer Gülpınar, 2013) . Regarding the most publication titles (Journals) interested in the BRDC, the highest publication title was Veterinary Microbiology, which publishes evidence of improvements and the expansion of scientific knowledge supporting infectious diseases (Silver *et al*., 2011).

In order to identify the most targeted and emphasized content, topics, and keywords in the field of BRDC research, we used Vosviewer to produce a co-occurrence analysis for the current study. It has been discovered that co-occurrence analysis provides insights into the most prevalent concepts, themes, patterns, and trends that could be taken into account when organizing scientific research in the future (Wang and Chai, 2018). The bibliographic coupling of documents and organization is one of the most crucial factors for the study of publications. To cite the third document in this analysis, two documents from two different organizations were combined. Bibliographic coupling strength can be used to assess bibliographic coupling (Moed, 2006). Recent research publications with fewer citations are also considered. Bibliographic coupling strength can be used to assess bibliographic coupling (Moed, 2006). Recent research publications with fewer citations are also considered. All recent works are shown in bibliographic coupling, and co-citation analysis includes older and foundational studies. It illustrates the state of intellectual organization in a certain scientific trend at the moment (Boyack and Klavans, 2010). According to some reports, coupling analysis is more robust than co-citation analysis (Boyack and Klavans, 2010).

Conclusion

In this investigation, for the first time, using bibliometric analysis, we provided an insight into the studies conducted on BRDC. These results indicate a growing number of studies on BRDC, which reflects the clinical significance of the disease globally. The present findings can help to establish the possible forthcoming plans for its prevention and control.

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Conflict of interest

The authors have no conflict of interest to declare.

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