RESEARCH NOTE

Research on Babesia: A bibliometric assessment of a neglected tick-borne parasite [version 1; referees: 1 approved with reservations]

Alfonso J. Rodriguez-Morales¹,², D. Katterine Bonilla-Aldana³,
Juan Pablo Escalera-Antezana²,⁴, Lucia Elena Alvarado-Arnez²

¹Public Health and Infection Research and Incubator Group, Faculty of Health Sciences, Universidad Tecnológica de Pereira, Pereira, Risaralda, 660001, Colombia
²School of Medicine, Universidad Franz Tamayo/UNIFRANZ, Cochabamba, Cochabamba, 4780, Bolivia
³Grupo de Investigación Sanidad Animal, Fundación Universitaria Autónoma de las Américas, Pereira, Risaralda, 660003, Colombia
⁴Tongji Hospital & Medical College, Huazhong University of Science & Technology, Wuhan, Hubei, 1037, China

Abstract

Given the emergence and reemergence of tick-borne diseases, here we assessed the publishing patterns of research focused on Babesia. We also discuss the implications for the articles published in the last decade, and how more clinical and epidemiological information concerning Babesia is still required. The findings of this article would be useful to define research priorities about Babesia and diagnose the important of scientific production on this pathogen.

Keywords

Babesia, tick-borne disease, epidemiology, public health, bibliometric

This article is included in the Disease Outbreaks gateway.
Introduction
Babesiosis is a zoonotic disease with a global distribution; it is mainly transmitted by ticks of different genera (e.g., *Rhipicephalus* spp. and *Dermacentor* spp.) and diverse species. It is caused by infection of the erythrocytes of mammals by *Babesia* species, which are Apicomplexa protozoa of the suborder Piroplasmidea and the family Babesiidae. The vector role of ticks for these parasites was discovered by Smith and Kilbourne in 1893, who were the first to demonstrate its transmission. The first case was described by Skaraballo and occurred in 1957 in Zagreb, Croatia.

Human babesiosis is not under surveillance and notification in most countries, including those with autochthonous incidence vector-borne diseases. However, studies show that their vectors are widely distributed in tropical and subtropical areas. Research is fundamental to better comprehending this disease. The relevance of bibliometric evaluations on emerging and reemerging diseases has been previously described as they can contribute in the understanding on how the global scientific and health communities respond to outbreaks. Herein, our objective was to use bibliometric approaches to analyze *Babesia* research.

Methods
A bibliometric evaluation was performed focusing on *Babesia* scientific bibliography. Six main databases were used for retrieving information: Science Citation Index Expanded (SCI-E), Scopus, Medline, LILACS, SciELO and Google Scholar. For the search pipeline we used the following combination of key words (MeSH, Medical Subject Headings): “*Babesia*” AND “Latin America”, “*Babesia*” AND “Argentina”, “*Babesia*” AND “Colombia”, and this strategy was maintained including the name of each country as a keyword. Also, “Babesiosis” was used as a substitute of *Babesia* to increase the number of results. Regarding the type of publications, we decided to include original papers, review articles, case reports and editorials, which were further stratified according to publication year and the name and institution to which the main author was affiliated at the time of publishing. This analysis included results obtained up to December 1, 2018.

Data summaries for quantitative variables (number of articles, articles per country, articles per year or periods, citations and H index) were expressed as means and interquartile ranges (IQRs), and for qualitative variables proportions are reported.

Results
Overall, 78,137 *Babesia*-associated items resulted from the initial screening of publications. From Google Scholar 62,100 articles (25% USA, 24.9% South Africa, 18.5% Japan) were recovered, followed by Scopus, with 6,272 articles (25.4% from USA, 8.5% Japan, 7.2% UK), and Medline with 5,045 articles (13.7% USA, 10.1% Japan and 5.2% China) (Table 1). From Web of Science, 4,330 publications were retrieved (28.06% from USA, 11.4% Japan and 7.37% Brazil), followed by LILACS with 202 articles (29.2% Brazil, 2.4% Mexico, 1.9% USA) and

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Number of articles</th>
<th>Database with highest number of articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States of America</td>
<td>1594</td>
<td>Scopus</td>
</tr>
<tr>
<td>2</td>
<td>Japan</td>
<td>536</td>
<td>Scopus</td>
</tr>
<tr>
<td>3</td>
<td>United Kingdom</td>
<td>456</td>
<td>Scopus</td>
</tr>
<tr>
<td>4</td>
<td>Australia</td>
<td>424</td>
<td>Scopus</td>
</tr>
<tr>
<td>5</td>
<td>Germany</td>
<td>324</td>
<td>Scopus</td>
</tr>
<tr>
<td>6</td>
<td>Brazil</td>
<td>319</td>
<td>Web of Sciences</td>
</tr>
<tr>
<td>7</td>
<td>China</td>
<td>284</td>
<td>Web of Sciences</td>
</tr>
<tr>
<td>8</td>
<td>France</td>
<td>256</td>
<td>Scopus</td>
</tr>
<tr>
<td>9</td>
<td>South Africa</td>
<td>254</td>
<td>Web of Sciences</td>
</tr>
<tr>
<td>10</td>
<td>India</td>
<td>195</td>
<td>Scopus</td>
</tr>
<tr>
<td>11</td>
<td>Poland</td>
<td>189</td>
<td>Web of Sciences</td>
</tr>
<tr>
<td>12</td>
<td>Spain</td>
<td>178</td>
<td>Scopus</td>
</tr>
<tr>
<td>13</td>
<td>Argentina</td>
<td>178</td>
<td>Medline</td>
</tr>
<tr>
<td>14</td>
<td>Italy</td>
<td>172</td>
<td>Scopus</td>
</tr>
<tr>
<td>15</td>
<td>Netherlands</td>
<td>136</td>
<td>Scopus</td>
</tr>
<tr>
<td>16</td>
<td>Turkey</td>
<td>119</td>
<td>Web of Sciences</td>
</tr>
<tr>
<td>17</td>
<td>Mexico</td>
<td>116</td>
<td>Medline</td>
</tr>
<tr>
<td>18</td>
<td>Switzerland</td>
<td>101</td>
<td>Scopus</td>
</tr>
<tr>
<td>19</td>
<td>Kenya</td>
<td>98</td>
<td>Scopus</td>
</tr>
<tr>
<td>20</td>
<td>Israel</td>
<td>93</td>
<td>Scopus</td>
</tr>
<tr>
<td>21</td>
<td>Egypt</td>
<td>82</td>
<td>Web of Sciences</td>
</tr>
</tbody>
</table>
SciELO with 188 articles (26.6% Brazil, 3.1% Mexico) (Table 1). Considering the Medline database, the number of research articles on Babesia increased above 100 publications per year only after 2004 (Figure 1).

In the case of Scopus, the median number of articles published each year as of 1970 was only one (IQR: 0-3), from 1970 until 1995 this number increased to 64 (IQR: 56-73) and from 1996 till 2018 was 188 (IQR: 115–271) (Figure 2). At Scopus 134 countries contributed a minimum of one paper over the study period. For SCI-E, the annual median number of articles reported from 1996 until 2018 was of 99 (IQR: 96-103) (Figure 3), with at least one article published from 129 countries during the study period.

“Obihiro University” in Hokkaido, Japan, was the institution with the most productive research in Scopus, and “Igarashi, I” was the author with the largest record in Babesia research, with 210 articles (Figure 4 and Figure 5). At Web of Sciences, the H index for the topic is 88, with 70,950 citations, reaching 7,734 citations in 2017 (Figure 6).

The raw data generated in this study are available on OSP9.

Discussion
The results presented here show that the USA and Japan have primary roles in Babesia research, with USA leading the scientific production with nearly quarter of the published articles, followed by Japan and the UK (Table 1). Certainly, in USA, tickborne disease occurrence is frequent especially in certain areas and months over the year. Tickborne diseases such as babesiosis are commonly reported in Northeastern states as well in the upper Midwest, often with higher incidence in summer. In addition, blood transfusions is still a matter of concern, even in the USA10–13. In countries in Asia, such as Japan, human babesiosis was not reported until fairly recently (1999), when a symptomatic case was describe in Kobe City, Hyogo Prefecture, Japan14,15; however, since then research has significantly increased in this country. Authors from UK have collaborated with research with others from endemic countries. However, in 2006 and 2016, two cases of autochthonous canine babesiosis were reported in the UK. Since November 2015, there have been at least three more cases of canine babesiosis in untraveled dogs from Essex, all were confirmed B. canis infections by PCR. Dermacentor reticulatus ticks were found on the dogs16.

One of the relevant aspects surrounding babesiosis is that there are not yet licensed human prophylactic vaccines, and treatment alternative remain limited. Two commonly used antimicrobial regimes are highly effective: the combination of atovaquone and azithromycin and the combination of clindamycin and quinine17. Thus, most preventive measures are needed to reduce the risk of infection from ticks and wild and domestic reservoirs (e.g. rats).

Bibliometric analyses contribute an objective vision of the scientific activity of a country or a region, in an investigative area. In the particular case of infectious diseases, there are different reports about its utility5–8, especially in emerging infectious
Figure 2. Research trends on *Babesia* from 1931 to 2018, Scopus.

Figure 3. Research trends on *Babesia* from 1996 to 2018, Web of Science.
Figure 4. Top research institutions that published scientific literature on *Babesia*, Scopus.

Figure 5. Top research authors that published scientific literature on *Babesia*, Scopus.

Figure 6. Citation trends on *Babesia* from 1931 to 2018, Web of Scopus.
In conclusion, it is time to translate research findings into effective control of babesiosis. As occurs with other emerging diseases, research leading to vaccinal or effective therapeutic options are of utmost importance. Tick-borne pathogens such as *Babesia* and others with even clearer epidemic potential need to be researched more and to be prioritized with effective interventions to reduce their negative impact.

**Data availability**

Raw bibliometric data generated in this study are available on OSF. DOI: https://doi.org/10.17605/OSF.IO/ER9U9.

**Grant information**

The author(s) declared that not grants were involved in supporting this work.

**References**

   - Reference Source
Open Peer Review

Current Referee Status: ?

Version 1

Referee Report 08 February 2019

https://doi.org/10.5256/f1000research.19225.r42304

Stalin Vilcarromero 1,2
1 Division of Infectious Disease, Department of Medicine, Stony Brook University, New York, NY, USA
2 Sociedad Científica de Estudiantes de Medicina de la Amazonia Peruana (SOCIEMAP), Facultad de Medicina, Universidad Nacional de la Amazonia Peruana, Iquitos, Peru

In the manuscript entitled “Research on Babesia: A bibliometric assessment of a neglected tick-borne parasite” the authors try to evaluate the previous bibliometric research regarding babesiosis in the world. It has recognized the value of this type of study because it helps to identify the importance of a country, institution or researcher in solving problems based on scientific evidence. Most of them describe bibliometrics in their papers considering bibliometric variables such as number of citations, author participation in research production, author and co-authorship analysis with VOSviewer1, the H-index, geographical distribution of that disease by countries, the amount and intensity of their international collaboration, analysis of that research based on the frequency of the words used in the title of the articles2, number of publications with intra-country collaboration, number of publications with inter-country collaboration3,4 etc, and usually, the literature was retrieved using only one database (Scopus, Medline, etc) which may give the advantage to let them analyze this in depth.

However, when the number of publications is normalized by population1, by gross domestic product, and by gross national income per capita5, health expenditure6, scientific collaboration7 or other important variable (epidemiology variables such as prevalence, incidence8, endemic versus non-endemic, etc) it makes more relevant the study. On the other hand, it is known the capacity of databases such Scopus, Medline, Web of Science and Scielo, and the authors may decide to use only one giving more details to the analysis.

In this case, considering that Babesiosis is a neglected disease, of importance in several countries as it has been described in the manuscript, so this topic deserve still more research, so I consider that this bibliometric analysis would be important for the scientific community. However, it would also be important to normalize the number of publications (including some of those variables mentioned above), include other bibliometric variables such as H-index.

References


**Is the work clearly and accurately presented and does it cite the current literature?**
Yes

**Is the study design appropriate and is the work technically sound?**
Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**
Partly

**If applicable, is the statistical analysis and its interpretation appropriate?**
Yes

**Are all the source data underlying the results available to ensure full reproducibility?**
Yes

**Are the conclusions drawn adequately supported by the results?**
Yes

**Competing Interests:** No competing interests were disclosed.

**Referee Expertise:** Clinical and epidemiological research in Vector Borne Disease

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.
The benefits of publishing with F1000Research:

- Your article is published within days, with no editorial bias
- You can publish traditional articles, null/negative results, case reports, data notes and more
- The peer review process is transparent and collaborative
- Your article is indexed in PubMed after passing peer review
- Dedicated customer support at every stage

For pre-submission enquiries, contact research@f1000.com