Infectious disease research in the Association of Southeast Asian Nations region: a scientometric analysis

Joseph Christian Obnial¹, Catherine Joy Escuadra², Adriana Viola Miranda³, Don Eliseo Eliseo Lucero-Prisno, III⁴,⁵,⁶

¹National Coalition of Independent Scholars, Battleboro, VT, USA
²Department of Physical Therapy, College of Rehabilitation Sciences, University of Santo Tomas, Manila, Philippines
³Global Health Focus Asia, Bandung, Indonesia
⁴Department of Global Health and Development, London School of Hygiene and Tropical Medicine, London, UK
⁵Office for Research Innovation and Extension Services, Southern Leyte State University, Sogod, Philippines
⁶Faculty of Management and Development Studies, University of the Philippines Open University, Los Baños, Philippines

ABSTRACT

Objectives: This study compared the research output of Association of Southeast Asian Nations (ASEAN) countries to understand research trends and clarify past, present, and future patterns using scientometric techniques.

Methods: This scientometric study systematically mined health and social science publications from the Web of Science and Scopus databases using keywords associated with infectious disease. The analysis included only English-language articles and review articles by authors from any ASEAN country. Publication, citation, and text co-occurrence network analyses were performed. R Studio and VOSviewer enabled data management, analysis, and visualization.

Results: Searches identified 12,511 articles published between 1925 and 2022, with a notable increase in research publications since 2003. The leading journals on infectious disease were associated with established publishing houses, including BMC, BMJ, and The Lancet. The most-cited articles were primarily global burden of disease studies, with 7,367 citations. Among ASEAN countries, Thailand, Malaysia, and Singapore had the most publications and collaborative efforts on the topic. Analysis of keyword co-occurrence revealed clusters related to global health, dengue, bacterial studies, non-dengue viral topics, and diagnostics. Most early studies examined diagnostics, gene and sequencing methodologies, and virology; later, the focus shifted toward herbal and alternative medicine.

Conclusion: Recently, the research capacity of Southeast Asia has expanded dramatically, with substantial contributions from high-income countries. Intense cooperation between member states is essential, emphasizing the role of HICs in supporting their neighbors. Increased research efforts must be dedicated to innovative approaches to combat persistent health conditions, along with emerging issues like climate change.

Keywords: Association of Southeast Asian Nations; Infectious disease; Scientometric analysis; Southeast Asia
Introduction

Southeast Asia (SEA) has long been a hotspot for infectious diseases. The region's dense population accounts for approximately 8.5% of the global total, and the high poverty rates among its inhabitants contribute to the continued prevalence of diseases such as tuberculosis and other respiratory infections [1,2]. The tropical climate of SEA, coupled with a propensity for storms and flooding, fosters the spread of vector-borne illnesses such as dengue, malaria, and schistosomiasis, as well as neglected tropical diseases like leptospirosis [1,3]. The Association of Southeast Asian Nations (ASEAN) comprises 10 countries within this region, most of which are still grappling with these health challenges. Member states include Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. The presence of infectious diseases in SEA represents an ongoing health and human security issue, one that could be more effectively addressed with strengthened regional collaboration [4].

Accordingly, the ASEAN member states have expressed a growing commitment to regional public health research and surveillance [5]. The emergence of coronavirus disease 2019 (COVID-19), alongside the existing burden of communicable diseases in the area, has placed additional pressure on regional efforts to reduce this burden [6,7]. Consequently, interest has coalesced around the establishment of a central infectious disease center to better coordinate these initiatives [7,8]. This has been paired with calls for increased cooperation among countries to generate new findings that could contribute to the eradication of infectious diseases [9]. Within the ASEAN Post-2015 Health Development Agenda, addressing hazards and emerging threats is a priority, most notably communicable diseases, neglected tropical diseases, and emerging and re-emerging infectious diseases, including zoonoses [10].

In recent years, a rapid yet uneven surge in the number of publications from ASEAN countries has been observed as these nations strive to bridge the gap with North America and Europe in research output [11]. Efforts must be made to identify research trends and gaps to effectively outline the research agenda for infectious diseases within the region. Scientometric studies are valuable tools for analyzing publication patterns and trends, potentially shedding light on the research contributions of ASEAN countries and guiding future research endeavors. While several bibliometric studies have been published recently, these have been either disease-specific, focusing on infections such as schistosomiasis, chikungunya, and COVID-19, or limited to particular countries within the region [12–15].

Given the commitment to research across the region and the similarity in climate, adopting a regional perspective is imperative. Accordingly, this study aims to evaluate the research productivity of ASEAN countries, chart temporal trends in research from the region, and provide insights into past, present, and future patterns through the use of scientometric techniques.

Materials and Methods

Study Design

This study employs scientometrics, a quantitative method for analyzing scientific research [16]. Scientometrics investigates knowledge structures and emerging trends by quantitatively analyzing various elements, including documents, high-impact journals, research cooperation networks, knowledge domains, and information about trends through literature co-citation and cluster analysis [17]. While this approach displays some overlap with bibliometric techniques, scientometrics is distinguished by its primary focus on understanding science and technology, as opposed to bibliometrics’ emphasis on publication and citation trends within the literature. Scientometrics has been used to compare research outputs on global health issues, such as human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) and depression, in various countries across Africa and Asia [18,19]. Consequently, it provides valuable insights into the current state and potential future trends in areas such as...
research, policy, education, and health. Figure 1 presents an overview of the methods used in this study.

**Databases**
The databases used to access indexed journal articles were Web of Science (WoS) and Scopus. These resources allow users to filter results by location and to extract important details such as author information, publication dates, citation numbers, and abstracts for analysis. Additionally, WoS and Scopus have been acknowledged as primary sources for other scientometric studies in the health field, due to their broad interdisciplinary coverage that serves a wide range of research areas [17,20].

**Data Search and Extraction**
Table S1 presents the Medical Subject Heading (MeSH)-based keywords used in the search. This search was limited to works by authors affiliated with institutions in ASEAN countries, specifically Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. The results were further refined to include only English-language original research or review articles, ensuring the studies’ relevance and interpretability. Complete records of each publication, comprising publication and citation information as well as abstracts, were then extracted as plain text files from both WoS and Scopus. For data cleaning, the research employed various packages in R Studio, including Bibliometrix, tidyverse, and dplyr, to merge datasets, remove duplicates, and discard records with incomplete data. Additionally, the VOSviewer thesaurus file was employed to consolidate different variants of author names, journal names, institutional affiliations, and synonyms. Impact factors were sourced from the Journal Citation Reports 2023 by Clarivate Analytics, and source normalized impact per paper values for 2023 were obtained directly from the Scopus sources database.

**Data Analysis**
Analysis was conducted using R Studio (Posit Software, PBC) and VOSviewer ver. 1.6.18 (Universiteit Leiden and CWTS Meaningful Metrics). Initially, R Studio was employed to examine the publication and citation characteristics of the included articles. This analysis revealed the frequency and distribution of research publications and citations, illuminating the evolution of the topic [17]. The complete publication and citation records of the articles were downloaded as plain text files and thoroughly examined using VOSviewer for collaboration and text co-occurrence network analysis. The research collaboration network was constructed based on co-authorship data by country [17]. Additionally, a text co-occurrence network was created by analyzing the titles and abstracts of the included publications. This meticulous process resulted in the establishment of 2 text networks, enabling the identification of clusters of frequently co-occurring keywords and the exploration of the evolving usage of keywords over time [21]. Finally, VOSviewer and Microsoft Excel (Microsoft Corp.) were used to generate maps based on the network and text data. These visual representations provided a clearer and more thorough understanding of the research findings.

**Results**
A total of 12,511 articles published between 1925 and 2022 were retrieved and analyzed for this study. Figure 2 illustrates publication trends in infectious disease research over the years in the ASEAN region. The analysis revealed a significant increase in research publications since 2003, with 76.91% originating from the last decade. The average number of citations per publication was 15.72, and the H-index was 53. Additionally, the average number of citations per publication was 34, with an H-index of 168.

Figure 3 presents the research productivity by country, using darker shades to represent higher levels of productivity compared to nations with lighter shades. The calculated values for research productivity among ASEAN countries are as follows: Thailand (45.27%), Malaysia (32.77%), Singapore (30.99%), Indonesia (24.73%), Vietnam...
Figure 2. Trends in published articles on infectious diseases from Association of Southeast Asian Nations countries from 1925 to 2022.

Figure 3. Geographical distribution of publications among the Association of Southeast Asian Nations member states.
(15.17%), the Philippines (10.60%), Cambodia (3.97%), Laos (2.02%), Myanmar (1.82%), and Brunei (0.95%). Tables 1 and 2 supplement this information with data on the frequency of publications by institution and author, further substantiating the observed productivity levels within the ASEAN region. The leading institutions in infectious disease research were the National University of Singapore (n = 920), Mahidol University (n = 797), Universiti Malaya (n = 347), and Chulalongkorn University (n = 315). Prominent authors in this field included Abubakar S, Omar AR, Leo YS, and Murray CJL.

Tables 3 and 4 summarize the leading journals in infectious disease research and the most-cited articles within the field. The top 3 journals in terms of the number of publications were the *International Journal of Infectious Diseases*, PLoS One, and BMC Public Health. Notably, the most frequently cited articles predominantly pertained to the global burden of disease (GBD).

Figure 4 illustrates the collaboration network related to infectious disease publications involving authors from the ASEAN region. The analysis of country collaboration indicates that Thailand and Singapore led in the number of collaborations. These countries most frequently partnered with the United States, the United Kingdom, Japan, Taiwan, New Zealand, and India. Additionally, the data reveal a comparable level of collaboration between these countries and other ASEAN member states. In contrast, Malaysia displayed a high degree of collaboration with nations from the Middle East and Africa. The country with the least collaboration was Brunei, which primarily partnered with Singapore, China, Indonesia, the United States, the United Kingdom, and Malaysia.

Figure 5 presents a text map that highlights the most frequently used keywords and their patterns within the titles and abstracts of all reviewed publications. These keywords were clustered based on their co-occurrence frequency in each publication. The findings revealed that research on infectious diseases in the ASEAN region formed distinct clusters of co-occurring keywords. These clusters included global health (highlighted in red), dengue...
Table 4. The most-cited articles on infectious diseases from ASEAN countries

<table>
<thead>
<tr>
<th>Title</th>
<th>Year</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiretroviral therapy for the prevention of HIV-1 transmission</td>
<td>2016</td>
<td>5,844</td>
</tr>
<tr>
<td>Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010</td>
<td>2012</td>
<td>5,704</td>
</tr>
<tr>
<td>Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013</td>
<td>2015</td>
<td>3,425</td>
</tr>
<tr>
<td>Coronavirus Disease 2019-COVID-19</td>
<td>2020</td>
<td>3,407</td>
</tr>
<tr>
<td>Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015</td>
<td>2016</td>
<td>2,781</td>
</tr>
</tbody>
</table>

ASEAN, Association of Southeast Asian Nations; COVID-19, coronavirus disease 2019.

Figure 4. Country collaboration mapping of publications by authors from the Association of Southeast Asian Nations region.

(in light blue), bacterial studies (in green), and non-dengue viral subjects such as hepatitis B, antiretroviral therapy, and HIV (in yellow). Additionally, clusters were identified related to diagnostics, such as gene, sequence, and reverse transcription polymerase chain reaction (in purple and blue). Moreover, most keywords in publications from ASEAN countries focused on research pertaining to GBD (e.g., life year, estimate, disability, mortality) and diagnostics (e.g., ...
Figure 5. Keyword co-occurrence network of articles published by Association of Southeast Asian Nations member states on infectious diseases from 1925 to 2022. The minimum number of occurrences is set at 5; the number of terms is 450. (A) Network visualization. (B) Overlay visualization, where keywords from older publications are shown in darker colors (blue and purple), while those from more recent publications are in lighter colors (green and yellow).

antigen, pathogen, virus, culture). Other keyword clusters pertained to policies and guidelines (e.g., health practice, quality, implementation, health system, framework), risk factors for infectious diseases (e.g., diet, age, obesity, physical activity, education, smoking, education), and transplacental transmission (e.g., mother, HIV, delivery, antiretroviral, hepatitis B). Notably, the latter were unique to publications from Thailand and Indonesia (Figure S1).

Regarding temporal trends, early research from the ASEAN region predominantly focused on viral conditions and improving diagnostics through the integration of polymerase chain reaction, gene, and sequencing techniques. In contrast,
Discussion

This is the first scientometric study to analyze the entire research landscape of infectious diseases in the Southeast Asian region without publication date restrictions. While bibliometric studies have examined individual disease entities such as COVID-19, dengue, chikungunya, and schistosomiasis [13–15,22], this study provides a more comprehensive view of the trends in infectious disease research within this region.

Although SEA faces a high burden of infectious diseases, until recently, little research from the region has focused on these conditions. A 2022 study revealed that SEA exhibited the second lowest contribution to global research output on 23 infectious disease outbreaks, accounting for only 10.3%. However, our analysis indicates a rising trend in research over time. A particular increase is evident since the onset of the COVID-19 pandemic, aligning with worldwide research trends. This surge is attributable to the efforts to discover treatments and preventive strategies in response to the pandemic [23]. Furthermore, the COVID-19 pandemic has heightened interest in other infectious diseases, as global stakeholders shift their focus towards preparing for future pandemics and outbreaks.

A wide disparity in research productivity is evident among the ASEAN member states, with high-income countries (HICs) exhibiting apparent dominance. Thailand, Malaysia, and Singapore, representing 3 of the 5 upper-middle to high-income member states, contribute the most research to this field [24]. This observation is consistent with bibliometric studies demonstrating a correlation between a stronger economy and a higher research output [12,14,15,25].

International collaboration also contributes to increased research productivity [26]. For instance, Thailand and Singapore have ongoing partnerships with institutions outside of the ASEAN. These include the Mahidol Oxford Tropical Medicine Research Unit (MORU) [27], a joint initiative between the University of Oxford and Mahidol University in Thailand, and the collaboration between the London School of Hygiene and Tropical Medicine (LSHTM) and the National University of Singapore [28]. These institutions also rank among the leading producers of infectious disease research in this region. Such formal partnerships facilitate the sharing of resources and information, thereby bolstering research capabilities and productivity.

The analysis of the most-cited articles reveals a lack of visibility regarding regional infectious disease research within the global landscape. Among the most frequently cited studies, research on GBD predominated. Although this indicates increased collaboration between the region and its counterparts [29], the scarcity of highly cited infectious disease studies specific to ASEAN member states suggests that the region's authority in this field is still limited [30]. Similarly, most of the 10 researchers with the highest productivity were authors of GBD studies and/or lacked affiliations in the region. Instead, they were associated with institutions such as the University of Washington, Oxford University, and the LSHTM, and some specialized in health metrics rather than infectious disease (such as McKee M, Day NP, Murray CJL, Hay SI, Mokdad AH, and Naghavi M). Only 2 authors—Leo YS and Lye DC, both from Singapore—hail from the region and primarily focus on infectious disease research. This underscores the need for an ASEAN infectious disease hub to cultivate regional expertise in communicable diseases. Furthermore, while regional collaboration is key, the influence of researchers collaborating with HICs must not be underestimated [26,31,32].

The choice of journal is a key consideration for ensuring that studies reach a broader audience. All of the leading publishers of infectious disease research from ASEAN countries are international journals. Higher journal citation indices, such as impact factors, are associated with increased citation of studies, reflecting a greater contribution to the body of knowledge [33]. However, these journals frequently charge substantial open-access fees, which may be prohibitive for countries with weaker economies [26,34]. Some ASEAN countries, including Cambodia, Laos, and Myanmar, benefit from waivers or discounts. Others, like the Philippines, Indonesia, and Vietnam, are not included in the discount policies of most major publishing companies, despite producing a considerable volume of research [35–38]. This creates an unnecessary barrier to the dissemination of infectious disease research from nations where these diseases are highly prevalent. Publishers should therefore take an active role in forming more inclusive agreements with these countries to support their participation in open-access publishing [34]. Another potential approach is for ASEAN to establish its own journal dedicated to research from its member states, similar to Eurosurveillance, the journal of the European Centers for Disease Control [39].

For these reasons, the importance of collaboration among member states cannot be overstated. With 4 countries in the region classified as HICs, strengthening ties between these countries and their lower-income neighbors is crucial. For example, Brunei—an HIC—ranks among the least productive and collaborative of the member states. Brunei...
has the potential to assist its more productive yet lower-income neighbors, thereby improving overall productivity in the region. Furthermore, the establishment of regional collaborations between state universities should be considered. Thailand, Malaysia, and Singapore, with their extensive experience, could lead such initiatives and encourage partnerships within the ASEAN network.

This study also revealed trends in infectious disease research within SEA. The most frequently cited articles primarily examined the epidemiology of diseases in the region, highlighting a consistently high prevalence of infectious diseases. Three additional studies focused on HIV and COVID-19, which are common in the region [40]. A clear interest has been expressed in exploring viral illnesses and improving diagnostic capabilities, with HICs often leading these efforts. It is also important to acknowledge the substantial work undertaken to understand the globally burdensome diseases that affect many of the member states. These efforts may stem from increased collaboration between ASEAN states and countries outside the region. The ASEAN Post-2015 Health Development Agenda, under the ASEAN Health Cooperation, specifically targets high-burden viral illnesses for the periods of 2016–2020 and 2021–2025 [10,41]. These diseases include dengue, rabies, and HIV/AIDS. Our study also revealed that Thailand places a distinct emphasis on HIV/AIDS research while conducting investigations into other sexually transmitted infections, such as hepatitis B, and research on transplacental and maternal transmission of infectious diseases. This focus may be attributed to the high prevalence of these conditions in Thailand, especially the country’s ongoing struggle with HIV/AIDS. Thailand’s increased research output is a critical part of its efforts to prevent the further spread of these diseases [42].

Despite the dramatic expansion of research in the region, considerable room remains for future research. Notably, the literature lacks studies of climate change and its relationship with infectious diseases, in both regional assessments and studies focused on individual countries. This gap persists even though climate change has been identified as a priority area for cooperation in the ASEAN Post-2015 Health Development Agenda [10,41]. Consequently, future collaborative research efforts in this region must examine climate change, particularly since SEA is expected to be severely impacted by rising sea levels and increasingly intense typhoons, which may exacerbate the prevalence of tropical diseases [43,44]. Moreover, there is a pressing need for intensive research into innovative approaches for epidemiological surveillance, detection, and treatment to address persistent diseases, including the challenge of antimicrobial resistance in conditions such as tuberculosis and malaria [44,45]. These diseases are also recognized as concerns in the regional health agenda. Finally, further research on health policy and frameworks must be conducted to support the eradication of preventable diseases through public health initiatives. These include addressing declining immunization rates, promoting antimicrobial stewardship, and combating health disinformation [1,44].

This study had some limitations. Notably, it included only research articles and reviews, with the aim of avoiding other types of articles—such as editorials, commentaries, and correspondences—that could artificially inflate the perceived research capacity of the region. Additionally, the absence of abstracts for commentaries and editorials within the selected databases rendered their inclusion in the final analysis infeasible. Furthermore, this study was limited to articles published in English, potentially overlooking studies published in the native languages of the region. Lastly, papers published in local journals may be not listed in WoS or Scopus, leading to their exclusion. However, this also highlights an underlying issue: the potential lack of capacity among countries in the region to achieve indexing, which often requires dedicated journal managers and infrastructure that local journals may lack. Despite these limitations, this study provides a robust overview of the research landscape in the region relative to similar studies that share these constraints [12,14,25].

Conclusion

This study analyzed the current research landscape of infectious diseases in the ASEAN member states, revealing remarkable growth in research productivity within the region in recent years, along with substantial contributions from HICs. Nevertheless, considerable work is still required in developing innovative strategies to address persistent challenges, such as the inadequate prevention and control of these diseases, particularly in low- and middle-income countries. Additionally, more efforts must be directed toward combating emerging threats, such as antimicrobial resistance, and mitigating the health impacts of climate change. The publishing community can further promote regional research growth through transformative agreements with countries in the area. Above all, improving collaboration among the member states is key to strengthening the health system through research that can help shape the region’s health landscape for decades to come.
Infectious disease research in the ASEAN region

Supplementary Material

Table S1. MeSH terms and keywords utilized during the search.

Figure S1. Keyword co-occurrence network per Association of Southeast Asian Nations member state of articles published on infectious disease from 1925 to 2022. Supplementary data are available at https://doi.org/10.24171/j.phrp.2024.0058

Notes

Ethics Approval
Not applicable.

Conflicts of Interest
The authors have no conflicts of interest to declare.

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None.

Availability of Data
All data generated and analyzed during this study are publicly available from the Web of Science and Scopus databases.

Authors' Contributions
Conceptualization: JCO, AVM, DELP; Data curation: CJE; Formal Analysis: CJE; Investigation: JCO, CJE, AVM; Methodology: CJE; Project Administration: JCO; Resources: CJE; Software: CJE; Supervision: DELP; Validation: JCO, CJE; Visualization: CJE; Writing–original draft: JCO, CJE; Writing–review and editing: all authors. All authors read and approved the final manuscript.

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