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A One Health information database based on standard bibliometric analysis

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ABSTRACT

Background: One Health is an integrated concept of health that aims to optimize the health of humans, animals, plants, and the environment. Identifying research gaps and specific expertise areas is important for understanding the role of One Health in practice. This information on One Health could be used to promote collaboration and research, inspire innovative ideas, and accelerate the translation of evidence-based practices into policies.

Methods: We searched the Scopus database for publications related to One Health between 2012 and 2021 to extract bibliometric information and investigate the possibility of establishing a dedicated expertise database. We matched scholarly information using SciVal to exclude duplicate information and identify scholars' affiliations, countries, and academic profiles. Individual academic contributions to One Health were evaluated according to their citations, publication impact, publication type, and author contributions.

Results: A total of 8,313 publications on One Health over a ten-year period were identified, with the number of publications increasing over time. The largest number of publications came from the United States and the United Kingdom. These countries also had the highest number of experts and a high level of international collaboration. We identified 500 scholars from 53 countries and 313 affiliations with a median Hirsch Index of 20 who could be included in a One Health expert database. These scientists had a median of six publications on One Health, with topics mostly focusing on dengue and antimicrobial resistance.

Conclusion: A One Health information database could be used as a third-party reference for scholars, a source to track the ongoing academic progress, and support for active scholars in this field of research.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has caused substantial economic loss and personal isolation worldwide, leading to social unrest [1]. The One Health concept of a holistic, multidisciplinary system linking humans, animals, plants, and environmental health has become a central research topic in relation to discovering the origins of COVID-19 and preparing for future pandemics [2]. Recognizing the complexity of health problems at the interface between humans, animals, plants, and related ecosystems, One Health constitutes a unifying, integrated approach that promotes overall health through multidisciplinary technology and multisector collaboration [3]. Apart from the importance

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of breaking down disciplinary barriers [4,5], it emphasizes closer cooperation between the human and veterinary fields of science by focusing on the role of the environment.

Since the first proposal of the One Health concept by William Kareshin in 2003 [6], there have been heated discussions followed by the rapid development of its core elements, revelant supportive techniques, and disciplinary groups. The Lancet One Health Commission was established in 2019, with 24 commissioners and several researchers from multiple disciplines included to promote interdisciplinary collaboration and generate solutions using the One Health strategy.

To support the control of zoonotic diseases, the Food and Agriculture Organization of the United Nations (FAO), World Organization for Animal Health (WOAH), formerly the Office International des Epizooties (OIE), and World Health Organization (WHO) launched a joint guide in 2019 titled "Taking a Multisectoral, One Health Approach: A Tripartite Guide to Addressing Zoonotic Diseases in Countries" [7] to enhance cross-sectoral collaboration. Following this initiative, the heads of the FAO, UN Environment Programme (UNEP), WHO, and WOAH created a multidisciplinary One Health high-level expert panel with the support of the governments of France and Germany in November 2020 [8]. This panel was launched in 2021 with 26 supporting key international experts selected to provide evidence-based advice and guidance. The panel aimed to address the health challenges raised at the interface of human and animal infections and their joint ecosystem so as to develop a long-term strategy to minimize the risk of zoonotic diseases. The following year, a new One Health Joint Plan of Action for the 2022–2026 period was jointly launched by the FAO, UNEP, WHO, and WOAH to address the health threats to humans, animals, plants, and the environment [9]. Nevertheless, despite all these collaborative activities, many challenges remain; for example, there is no comprehensive database to share information about research and implementation ideas on the One Health approach at local, national, and regional levels [10]. In addition, little information is available on the coordinated progress of multi-sector collaboration within and across countries. In some countries, despite several rounds of institutional reforms, there remains a lack of independent institutions that focus on One Health issues. Many departments and disciplines remain isolated, and there is little cooperation at many levels and areas [11].

The development of a comprehensive database would assist in sharing information related to One Health and help identify gaps in the various interfaces in diseases studies across humans, animals, plants, and ecosystems. Such a database should also help inspire innovative approaches for implementing One Health practice across countries and promote further research in this area. Therefore, it is important to develop a One Health database of leading expert knowledge to promote collaboration, build consensus, and provide guidance for transforming evidence-based practices into policies based on the latest research. To the best of our knowledge, no such database is currently available.

This study aims to provide a comprehensive information database to be used as a reference for the One Health strategy, which could systematically identify current academic work, research gaps, research journals, scholars, and institutional information.

2. Methods

2.1. Data sources and search strategy

We searched the Scopus database [12] for publications relevant to One Health activities. The keywords identified needed to have been referred to in the publication title, abstract, and keywords, and they were "One Health" OR "One medicine" OR "Ecohealth" OR "Ecology health". We also searched any publications with topics related to One Health from the Scopus SciVal database [13], including the following coded areas "One Health Initiative/Zoonosis/Communicable Disease" (T.20,471); "Pastoralists/Delivery of Health Care/One Health Initiative" (T.63,531); "One Health Initiative/Curricula/University Teacher" (T.80,769); and "Nigeria/One Health Initiative/Metallothionein" (T.92,826). We retrieved relevant publications published between January 2012 and December 2021 without language or publication type restrictions. Articles, reviews, books, book chapters, editorials, letters, short surveys, notes, and conference papers were included. We excluded duplicate and *erratum* publications from further analysis.

2.2. Data extraction and database establishment

For publication information, we extracted the title, author, Scopus author identification (ID), Scopus source title (journal), Source ID (journal ID), view count, citation count, publication type, unique publication ID in Scopus bibliographic database (EID), institution, Scopus affiliation, Scopus affiliation ID, Scopus first author ID and corresponding author, All Science Journal Classification (ASJC) code, ASJC field name (classified by Elsevier [14] to identify the subject area of each publication), topic cluster name, and topic cluster number (classified by Elsevier [15] to identify the topics of each publication). For any type of data that included IDs, we exclusively used these IDs to integrate the information if different name forms were used in multiple publications. Scopus author IDs can also help distinguish different authors with the same name [16]. We matched author IDs using SciVal to identify each author's affiliation, country, academic author profile, and Hirsch (H) index. For authors with more than one affiliation, the current affiliation was set as the main affiliation in the last five-year list of publications.

2.3. Data analysis

To identify scientists in the field of One Health, we evaluated the academic contribution of each scientist according to their total publication contributions related to One Health. This was accomplished by considering the number of publications, publication type, author contributions, citation count, and publication impact, as shown in the flowchart describing the development of the database (Fig. 1). We assigned weights to different publication types, author contributions, and publication impact, calculated a score ($S_{p,scien}$) for each publication and scientist using formula (1) and summarized the total score T_{scien} for each scientist using formula (2).

$$S_{p,scien} = \left(W_j + C\right) \times A_i \times PT \tag{1}$$

$$T_{scien} = \sum S_{p,scien} \tag{2}$$

where p is the publication; *scien* is the scientist; W_j is the publication impact based on the quantile results of the Scimago Journal Rank (SJR) indicator released in 2022 [17]; C is the log-transformed citation; A_i is the author contribution (reciprocal of author sequence, based on the author's position in the publication, with corresponding authors set to 1, regardless of their position in the author list), and PT is the publication type.

The detailed weights of the indicators are listed in Table 1. We also used alternative weight strategies assigned to publication types and publication impact and compared the differences among the weight strategies to test the robustness of the evaluation strategy. Refer to eMethods for more details on the alternative weight strategies and results.

The 500 scientists with the highest total scores were included in the One Health expert database. For each author, we attached country, affiliation, H index, number of publications, total views, number of citations by September 2022, total score, ranking, and top three topic clusters of their One Health research. We also provided summary statistics for the selected publications and scientists. Data processing, analyses, figures, and mapping were performed using **R** software (version 4.2.1; R Foundation, Vienna, Austria).

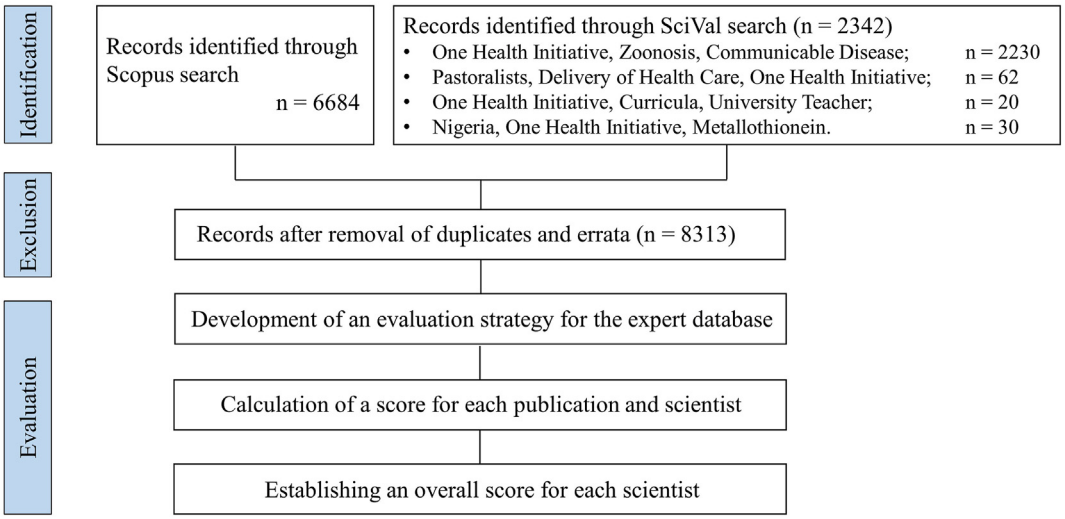

Fig. 1. Flowchart of the development of One Health database.

Table 1
Indicators, definitions, and weighting details for evaluating scientific contribution of scientists.

Indicators	Definitions
Number of publications	The number of publications in One Health of each scientist.
Publication types	Each publication was weighted according to its publication type, including article (1), review (0.8), book (1), book chapter (0.5), editorial (0.8), letter (0.3), short survey (0.5), note (0.2), and conference paper (0.2).
Author contribution	The reciprocal of author sequence. Contribution for the corresponding author was set to 1 regardless of their sequence in the publication.
Citation	Total number of citations received in September 2022.
Journal impact	The weight of journal impact was assigned to each journal based on the SCImago Journal Rank (SJR) indicator released in 2022, which compared journals within their thematic areas respectively, ranking from Q1 (highest) to Q4 (lowest) [17]. The SJR indicators were transformed to numeric weights as Q1 = 1, Q2 = 0.75, Q3 = 0.5 and Q4 = 0.25. Since there was no authoritative indicator to evaluate the impact of book or book chapter, we assumed a weight of 1 for them.

3. Results

3.1. Summary of One Health publications

We collected 8,313 publications for analysis, including 5,258 original articles (63.3%) and 1,505 reviews (18.1%), during the ten-year study period. The majority of publications were from Europe and Central Asia (39.5%), followed by North America (22.3%), and East Asia and the Pacific (15.1%). A continuous increase in the number of publications was observed, from 310 in 2012 to 2,121 in 2021 (Fig. 2). Specifically, only a few publications were published before 2016, after which the number grew slowly but steadily (annual growth rates varied from 0 to 30%). Since 2019, there has been a significant increase in the number of publications (an annual growth rate of approximately 50%). The number of citations of the 100 publications with the highest counts ranged from 115 to 637 (Table S1).

A summary of the publication of One Health related studies is presented in Table 2 and S2. A total of 8,313 publications came from 178 countries, with the highest proportions coming from the United States (US; 30.0%), the United Kingdom (UK; 15.2%), and Australia (7.7%). The global distribution of the publication frequencies across countries is shown in Fig. 3A. Cross-country collaborations showed that the US, UK, Australia, and European countries had the highest frequencies of collaborative research (Fig. 3B).

Of the 3,766 institutions we identified, the Centre National de la Recherche Scientifique in France (1.9%), the Centers for Disease Control and Prevention in the US (1.8%), and the London School of Hygiene and Tropical Medicine in the UK (1.7%) had the largest number of One Health publications. Of the 2,504 journals identified, One Health (2.2%), Frontiers in Veterinary Science (1.6%), and OIE Revue Scientifique et Technique (1.6%) published the highest number of One Health papers. Among the 304 ASJC fields identified, public health, environmental and occupational health (19.4%), infectious diseases (18.3%), and general veterinary (13.2%) were the most common. By cluster topic, the most common ones included the "dengue, viruses and dengue virus" group (28.8%), the "anti-bacterial agents, infection, methicillin-resistant *Staphylococcus aureus*" group (6.8%), and the "*Salmonella* spp, *Escherichia coli,* and *Listeria monocytogenes*" group (2.5%). Approximately 60% of all publications were assigned to more than one ASJC fields, and 7.4% to more than five. The research field network across publications is shown in Fig. 4. Scholars in the fields of infectious diseases, public health, environmental and occupational health, microbiology (medical), general veterinary, immunology and allergy, pharmacology, virology, and epidemiology have collaborated frequently.

3.2. Expert database of One Health

We identified 35,794 author records from the information database and selected the 500 scientists with the highest scores in the expert database (Table S3). The distribution was right-skewed, with only a small number of the 500 experts having high scores, with a median of 10 and an interquartile range (IQR) of 8.4 and 14.4. The maximum number of publications focusing on One Health per scientist was 54, with a median of 6. The number of citations varied from 11 to 3,183 (median: 129.5; IQR: 62.0, 283.2). The H indices of the experts ranged from 2 to 185 (median: 20; IQR: 12.0, 33.0). A total of 101 experts (20.2%) had H-indices above 40 (Table 3).

The 500 scholars were from 53 countries and had 313 affiliations. Among them, the US (22.4%), the UK (14.6%), Australia (6.6%), Canada (5.6%), and Italy (5.2%) had the highest number of One Health experts. With respect to affiliation, the University of Liverpool (1.8%), EcoHealth Alliance (1.6%), University of California at Davis (1.4%), University of Geneva (1.4%), and Centers for Disease Control and Prevention in the US (1.2%) had the highest number of experts (Table S4).

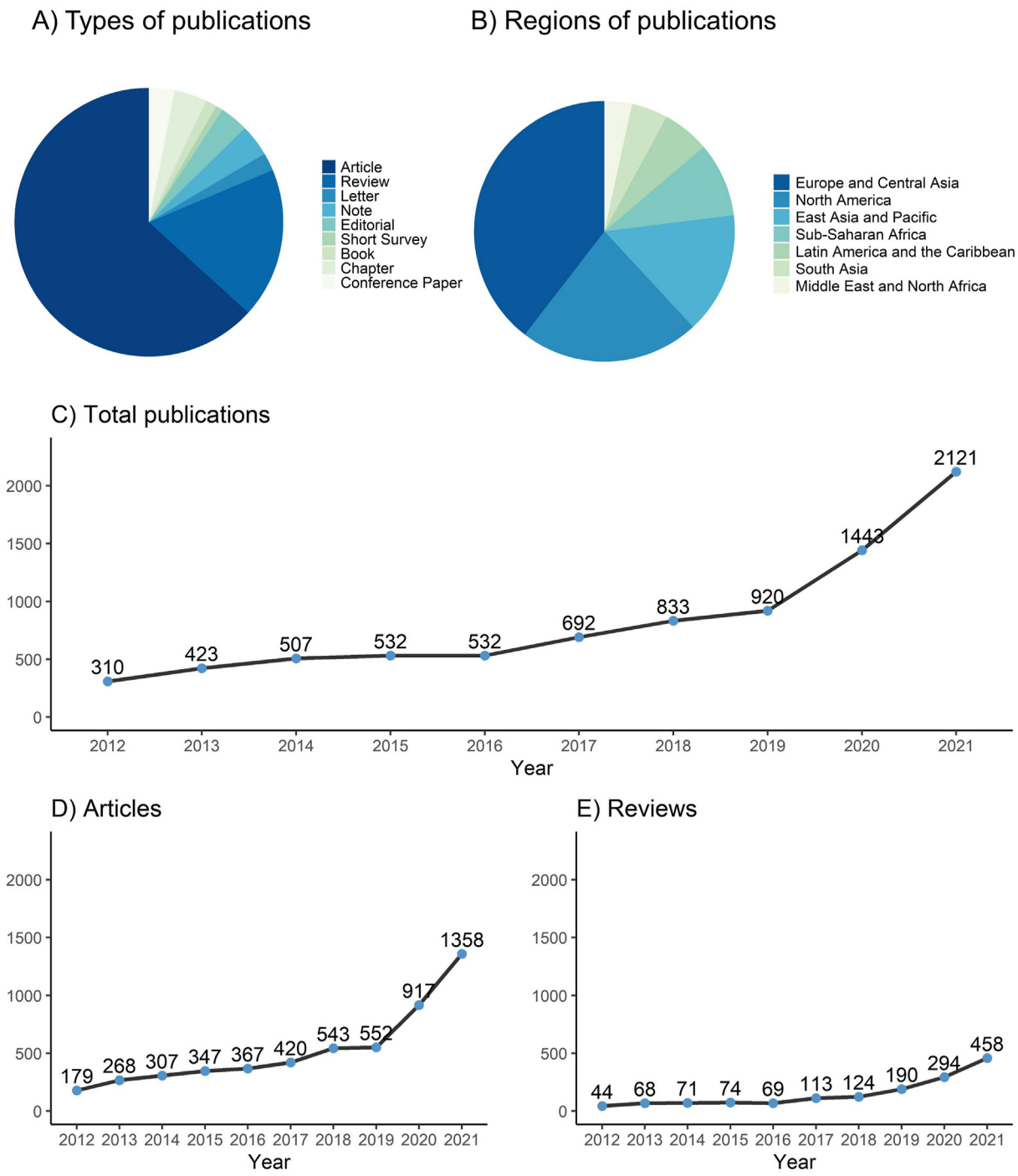

Fig. 2. Basic characteristics of the selected publications in One Health. A) Proportion of publication types; B) Proportion of the regional provenance of publications; C) Annual publication counts; D) Annual counts of original articles; E) Annual counts of reviews.

For each expert included in the database, we also identified topic clusters with respect to research fields. Among the 215 topic clusters, three attracted considerably more research than the others: 47.0% of experts conducted studies related to the group "dengue, viruses and dengue virus", followed by "anti-bacterial agents, infection, methicillin-resistant *Staphylococcus aureus*" (23.8%) and "*Salmonella* spp, *Escherichia coli*, and *Listeria monocytogenes*" (16.8%).

4. Discussion

The One Health information database comprehensively provides cross-disciplinary information on the current progress in research in this field. As mentioned in the FAO/UNEP/WHO/WOAH One Health Joint Plan of Action, multidisciplinary barriers, as well as a lack of resources and transparency for informationsharing, have impeded the implementation of One Health in practice [9,18]. In addition, previous studies have emphasized that existing One Health research has been predominantly based on hypotheses and expert ideas without sufficient empirical data. Collectively, these facts have hampered the need to develop a database that captures and quantifies the value of interdisciplinary approaches [19]. The proposed database can improve information sharing and correlate knowledge by identifying the world's leading relevant experts. According to the results, we found that a few industrialized countries, such as the US, the UK, and

Table 2
The summary of information extracted from the selected 8313 publication of One Health from 2012 to 2021. The top three of each item and their proportion were attached.

Items	Total counts	TOP1	TOP2	TOP3
Countries	178	United States (30.0%)	United Kingdom (15.2%)	Australia (7.7%)
Institutions	3766	Centre National de la Recherche Scientifique (1.9%)	Centers for Disease Control and Prevention (1.8%)	London School of Hygiene and Tropical Medicine (1.7%)
Journals	2504	One Health (2.2%)	Frontiers in Veterinary Science (1.6%)	OIE Revue Scientifique et Technique (1.6%)
ASJC[a]	304	Public Health, Environmental and Occupational Health (19.4%)	Infectious Diseases (18.3%)	General Veterinary (13.2%)
Topic clusters[b]	609	Dengue, Viruses, Dengue Virus (28.8%)	Anti-Bacterial Agents, Infection, Methicillin-Resistant Staphylococcus Aureus (6.8%)	Salmonella, Escherichia Coli, Listeria Monocytogenes (2.5%)
Topics[c]	2295	One Health Initiative, Zoonosis, Communicable Diseases (26.6%)	Antibiotic Resistome, Tetracycline Resistance, Anti-Bacterial Agents (1.9%)	Beta Lactamase, Enterobacteriaceae, Extended Spectrum Beta Lactamase (1.5%)

[a] ASJC: All Science Journal Classification, the discipline of the journal in which the individual paper is located. Serial titles are classified using the ASJC scheme. This is done by in-house experts at the moment the serial title is set up for Scopus coverage; the classification is based on the aims and scope of the title, and on the content it publishes. There are 4 subject areas and 334 fields (Last updated on May 27, 2020) [14].

[b] Topics: Nearly 96,000 research topics were created using the citation patterns of Scopus-indexed publications. The methodology for using citation patterns to define research topics was developed through Elsevier's collaboration with its research partners.

[c] Topic clusters are a higher-level aggregation of research topics based on the same direct citation algorithm that creates the topics. Although topics are easy for subject experts to understand, they are more difficult for subject generalists to comprehend. To help discover and understand topics, Elsevier aggregated them into approximately 1,500 topic clusters. When the strength of the citation links between topics reaches a certain threshold, a topic cluster is formed. Topic clusters are named according to the three most relevant key phrases within the cluster. Both topics and topic clusters are mutually exclusive; a publication belongs to only one topic and topic cluster [34].

Australia, are far ahead of all other countries in publishing One Health related studies with frequent cross-country cooperation. In contrast, few publications came from Africa and Asia, suggesting that more efforts should be made to enhance research cooperation in this part of the world, particularly in Central Asia and Eurasia. We also found the years 2016 and 2019 of particular interest, as they represent temporal key surges of One Health publication coinciding with the disease outbreaks of Ebola, Zika, Middle East Respiratory Syndrome, and COVID-19. The emergence of infectious diseases has played a facilitating role in One Health research. However, these findings may also reflect the absence of a long-term systemic plan for One Health research.

Based on the bibliometric evaluation, this information database was the first to identify the 500 top scholars publishing One Health-related research. Several existing databases provide scholarly rankings, such as Highly Cited Researchers [20], Essential Science Indicators [21] by Clarivate Analytics and Highly Cited Chinese Researchers by Elsevier [22]. Ranking by citation is an important indicator, and the H index has been widely used to evaluate the impact of scholars. However, evidence also shows that aggregating the citation statistics of publications into a single indicator may lead to inconsistencies [23]. Most ranking systems evaluate scholars' general academic contributions, sometimes in specific research fields; however, few have focused on understanding scholars' cross-disciplinary contributions [24]. Therefore, we developed an integrated ranking system with composite indicators to evaluate the diverse aspects of scientists' scientific impact and link scholarly information with their most common research topics in the field of One Health. Despite there could be difficulty in reaching a consensus for a common weighting strategy for each indicator, we used an alternative weighting approach to test the robustness of the results. Overall, this provided relatively stable results for most of the top 500 experts (Table S5). However, it should be noted that the purpose of ranking is not primarily to estimate scholars' general academic ability, but to share information to understand experts and their key research areas in relation to One Health. There are some excellent scientists who have well-recognized expertise in some specific research fields but do not appear in our database because we only focused on studies related to One Health.

The potential functions of the proposed database are twofold. First, it can provide information on research priorities and gaps with respect to One Health guiding young scientists when they select their research orientation and assist decision-makers in national and private research foundations as well as international organizations when they review the research panorama and specific proposals. For example, zoonosis, infectious diseases (especially dengue fever), and microbiology were popular research topics, whereas there were considerably fewer publications on food safety, climate change, and governance. Second, the database provides information that may trigger collaborations among partners with similar research interests. One Health research requires this approach, which would lead to integrated surveillance, joint human–animal vaccination programs, and increased investment in cost-effective interventions geared at the interface between humans and animals, as this holistic approach would bring overall benefits to all life in various ecosystems [25–29]. Importantly, this study found a clear limitation with respect to collaboration. Only a few papers on One Health were found in the fields of social science and humanities, and physical science, while the majority were in the fields of life sciences and health sciences. Collaboration is strongly connected to the One Health approach, and all areas discussed here would benefit from an emphasis on cross-discipline work.

Based on the aforementioned features of the information database, we propose the following recommendations to trigger more One Health research. Transdisciplinary collaboration would help to:

- Encourage collaboration at the interfaces between humans, animals, plants, and the environment, such as food security/safety, climate change, and One Health governance; in addition to work on zoonotic diseases and antimicrobial resistance [30,31];
- Promote collaboration between different continents, especially between industrialized and developing countries, as this is urgently required;
- Establish a shared topic and integrative framework, which is critical in the evaluation of the capacity of One Health research to make a difference;
- Lead to real-world projects while exploring and working on broad issues across countries and disciplines [32,33];
- Formulate a proactive and routine system for One Health practice and research in response to emerging, re-emerging, and local epidemics, leading to a long-term systemic plan for One Health research in each country.

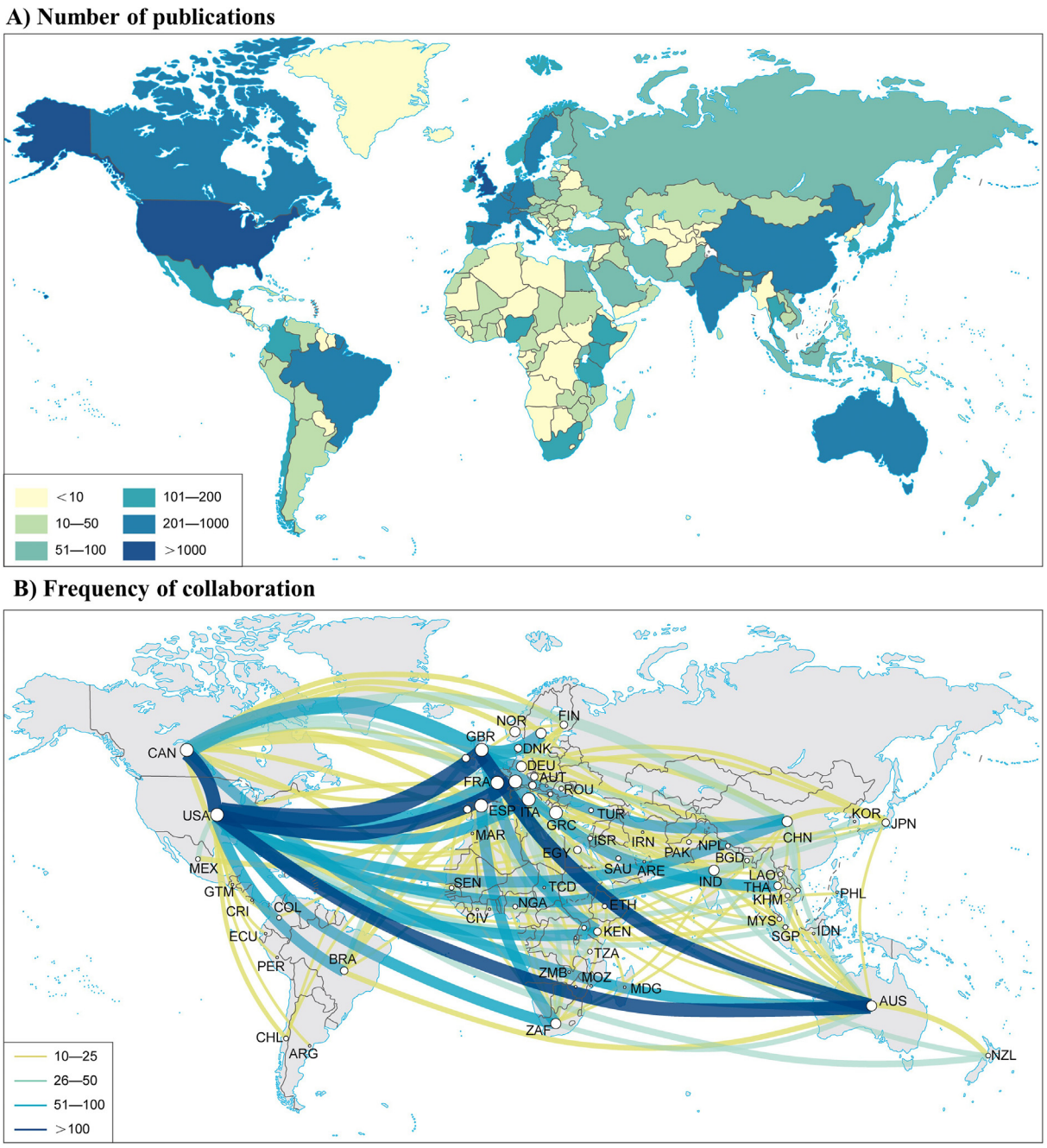

Fig. 3. Global distribution of the numbers of publications and frequency of collaborations across countries in the field of One Health. A) Numbers of publications; B) Frequency of collaborations. When the authors of a study represented the involvement of two countries, one path between the two countries was created (and counted); when three countries were involved, three paths were created (and counted), etc. The collaboration network was summarized according to the collaboration frequency in all One Health publications identified. Paths between two counties having less than ten collaborative activities are not shown.

However, several limitations of the database need to be mentioned. First, due to the lack of a larger dataset, we only managed to retrieve information from 2012 to 2021. Thus, this study might not reflect the full picture of One Health studies and the contributions of scholars. As the One Health concept is becoming increasingly popular, a growing number of scholars are likely to enter this field and producing notable research progress and field implementation cases in the coming future. To track the most recent progress, this database will be updated annually and released on the of One Health Action Commission website (https://www.shsmu.edu.cn/sghen/GOHI.htm). Second, we observed that a small number of experts had a large variation in the sensitivity rankings when changing the weights of publication impact based on the source-normalized impact per paper (SNIP), a measure of the contextual impact by weighting citations based on the total number of citations in a research field, meaning that a single citation is given higher value in subject areas where citations are less likely. This might have been because the COVID-19 pandemic has had a significant impact on health research, leading to significant fluctuations in the publication impact evaluation. Weighting strategies based on the SJR quantile results of each thematic area for publication impact may be more stable than other weighting strategies that consider the impact of the COVID-19 pandemic. Thirdly, our search strategy primarily depended on terms directly related to “One Health”, which may have resulted in some relevant publications being excluded if they did not contain this keyword. We acknowledge that identifying all relevant publications remains a big

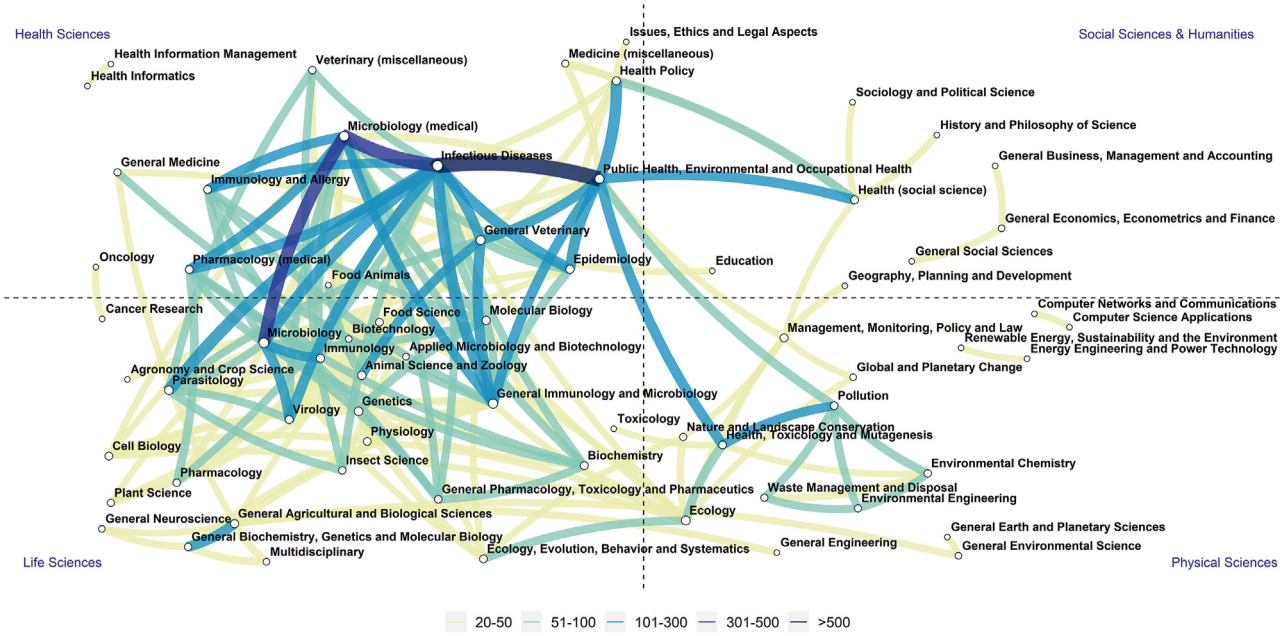

Fig. 4. Network of research fields among One Health Publications. Each publication was assigned at least one ASJC research field by Scopus. The connection between two fields was counted as one path if a study covered these two fields. If the study involved three fields, it was counted as having three connecting paths. Thus, a network contains all the research fields identified and is formed by the presence of paths connecting the One Health publications involved. The research fields in this figure are presented according to their subject areas, which include Health Science, Life Science, Social Science & Humanities and Physical Sciences presented with one in each of the four corners of the figure playing the role of areas of gravitation. To ensure all research fields were clearly shown in this figure, the location of each point was adjusted manually. The distances across each point have no special meaning. Paths between two fields with less than 20 publications are not shown.

Table 3
Summary of expert database of One Health.

Items	Median	Interquartile range	Range
Total score	10.0	(8.4, 14.4)	(7.4, 71.0)
Number of publications	6	(4, 9)	(1, 54)
H Index	20	(12, 33)	(2, 185)
Citations	129.5	(62, 238.2)	(11, 3183)

Abbreviation: H index, developed by J.E. Hirsch attempts to measure the output of a scientist or scholar and the impact of the published work. "If a scientist's NP papers are cited at least h times, and none of the other (NP–H) papers are cited less than h times, that person's H index is h." [35].

challenge because extending the search strategy would also identify much irrelevant records. This may result in identifying many experts from other fields who may have only published a few collaborative studies on One Health while substantially diluting publications and experts that purely focus on the field of One Health. The optimization of the search strategy and algorithm to distinguish relevant publications via artificial intelligence or natural language processing is expected in future studies. In addition, our evaluation methods were based on academic publications; experts who put more effort into field implementation than academic publications did not rank high in our database. Although this capability is difficult to gauge, we will attempt to include this measure when updating our methodology. Similarly, our current database may have excluded experts from other fields that are irrelevant to health, although their academic work may provide important technical support for One Health implementation, such as computer science, mathematics, psychology, engineering, and social science. Future versions of our algorithm will aim to include these experts.

5. Conclusions

In response to the gaps in information and a low level of collaboration in the field of One Health, we developed an information database based on ten years of progress in this research area. Data derived from this database should help advance the development of One Health, improve cross-institutional and cross-national collaboration, inspire innovative ideas, promote scientific research, and contribute to translating evidence-based practice into policy. Importantly, this database could be used as a reference for scholars and experts in the field of One Health.

Ethics approval and consent to participate

Not applicable.

Availability of data and materials

Data are available from Scopus and SciVal. Public-use data can be retrieved from https://www.scopus.com/search/form.uri?display=basic#basic and https://www.scival.com/home. Our results can be found on the website of the One Health Action Commission https://www.shsmu.edu.cn/sghen/GOHI.htm.

Consent for publication

Not applicable.

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Authors' contributions

LH conceived and designed the study. XW, SG, and LH acquired the data. SY and LH cleaned and analyzed the data. NQ, JR, and LH interpreted the results. NQ, JR, and LH drafted the manuscript. NQ, XW, SG,

ZJ, RB, JR, and LH revised the manuscript. All authors contributed to the content and critical revision of the manuscript and approved the final version.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Wen-Feng Gong reports financial support was provided by Bill & Melinda Gates Foundation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.soh.2023.100012.

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