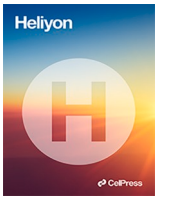
Heliyon 9 (2023) e19188



Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon





Analysis of congenital heart disease research: Mapping impact, production and global collaboration

J. Pierre Zila-Velasque [a,b,c], Pamela Grados-Espinoza [a,b], W Samir Cubas [d,e], Mario Diaz-Barrera [c,f], Josmel Pacheco-Mendoza [g,*]

[a] Universidad Nacional Daniel Alcides Carrion, Facultad de Medicina Humana, Pasco, Peru
[b] Red Latinoamericana de Medicina en la Altitud e Investigación, (REDLAMAI), Pasco, Peru
[c] Unidad de Investigación en Bibliometría, Vice Rectorado de Investigación, Universidad San Ignacio de Loyola, Lima, Peru
[d] Department of Thoracic and Cardiovascular Surgery, Hospital Nacional Edgardo Rebagliati Martins, Lima, Peru
[e] Thoracic Surgery Residents Association, USA
[f] Sociedad Científica de Estudiantes de Medicina de la Universidad Nacional de Trujillo, SOCEMUNT, Peru
[g] Universidad Científica del Sur, Lima, Peru

ARTICLE INFO

Keywords:
Congenital heart disease
Production
Collaboration
Research results
Bibliometric analysis

ABSTRACT

Background: Congenital heart disease (CHD) is a severe childhood health problem worldwide. This study analyzes the scientific production on CHD published in Scopus during the last decade.
Methods: This study assessed the research on CHD conducted during the 2011–2020 period. Indexed publications were identified using a list of keywords consisting of MeSH (Medical Subject Heading) and Emtree (EMBASE) terms for the category "Congenital Heart Defects." The studies obtained were analyzed using the SciVal platform, and the production, impact, and collaboration indicators were considered. Additionally, an analysis of co-occurrence between countries and keywords was carried out with the VOSviewer software.
Results: The study found 8934 articles on CHD. A growing trend was observed during the last decade. The distribution of the scientific production at the international level shows that most publications are from the United States, China, and the United Kingdom, whereas Latin American countries have the lowest production. The articles analyzed contain a total of 89,835 citations. Most studies are published in high-impact journals (Q1), with 3273 studies corresponding to 39.3% of the total production analyzed. In the keyword analysis, we found five areas investigated.
Conclusions: Scientific production has shown sustained growth in the past years. Increased scientific production in specific research areas may have helped decrease morbimortality due to CHD.

1. Introduction

Congenital heart disease (CHD) is defined as a structural anomaly of the heart and the great vessels existing from birth [1]. Although its prevalence is 19.6 in every 10,000 live births [2], its incidence has increased from 5.56 in every 10,000 births in 2010 to 136.46 in every 10,000 in 2019, becoming the most common congenital anomaly in 2013 [3]. Furthermore, it is the main cause of death due to non-communicable diseases (NCDs) among persons under the age of 20 years in regions that are characterized by a lack of

* Corresponding author.Universidad Científica del Sur, Lima, 150142, Peru.
E-mail address: josmel@gmail.com (J. Pacheco-Mendoza).

https://doi.org/10.1016/j.heliyon.2023.e19188
Received 6 October 2022; Received in revised form 10 August 2023; Accepted 15 August 2023
Available online 16 August 2023
2405-8440/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

adequate and timely access to healthcare [4,5]. In this same sense, the reduction of deaths by CHD as an NCD is part of the fulfillment of the Sustainable Development Goal that seeks to reduce the avoidable deaths of children under the age of 5 years by one third [4,6], which in 2019 was 3.23 of every 100,000 inhabitants age-standardized [4].

A previous bibliometric analysis found that scientific production on CHD was up to 29 times higher in developed countries than in developing countries [7]. Another study concluded that there is an immediate need to create a solid infrastructure of international collaboration that allows for improved scientific production on CHD [8]. However, no bibliometric analyses identify the leading institutions in scientific production by indicating which journals have the highest number of articles on CHD or analyzing the areas that have been researched the most in the last years. These updated data are necessary to guide and drive scientific production on CHD. Therefore, this study is aimed at conducting an analysis of the scientific production on CHD published in Scopus during the last decade.

2. Methods

2.1. Ethics statement

The data was downloaded from public databases; therefore, no ethical approval was obtained.

2.2. Study design and sources of information

This study consisted of a bibliometric analysis of the research on CHD in the 2011–2020 period. Scopus (Elsevier BV Company, Netherlands) was the database chosen to identify the studies because it is considered the most complete database worldwide, including 100% of the publications indexed in Medline [9].

2.3. Search strategy

Publications indexed by means of a list of keywords consisting of the Medical Subject Heading (MeSH) and Emtree (EMBASE) terms under the category "Congenital Heart Defects" were identified. This list was complemented with different terms related to diverse sources, such as articles and expert consultations. There were no restrictions on the types of articles analyzed. The search strategy used was as follows: ((TITLE (heart OR *cardia* OR coronary OR "atrial septal" OR ventricle OR pericardi* OR epicard* OR myocard*) AND TITLE (congenital) AND TITLE (a*no*mal* OR deformit* OR defect* OR malformatio* OR disorde* OR diseas* OR aberration))).

2.4. Data analysis

Data were processed through the SciVal platform (Elsevier) [10], which uses four different sections for the analysis of information—namely, overview, comparative evaluation, collaboration, and trends. Within these sections, countries; institutions (e.g., academia, industry, government, and hospitals); authors; publications; and thematic areas (i.e., clinic-epidemiology, diagnosis, management, and treatment) can be analyzed. Additionally, descriptive statistics were performed using Microsoft Excel 2019®, calculating absolute and relative frequencies for each variable of the study.

The following bibliometric indicators were used in the study:

(1) Scientific production per year and citation impact

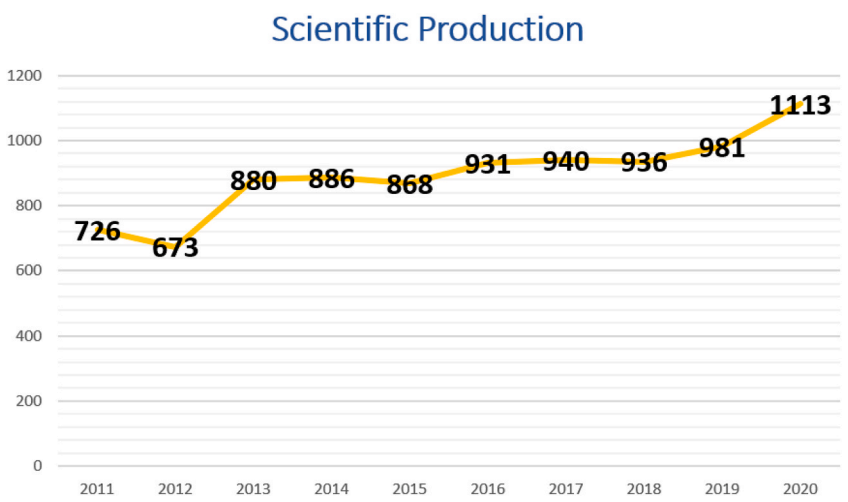


Fig. 1. Scientific production per year in the 2011–2020 period.

(2) Collaboration networks, represented by the percentage of international, national, and interinstitutional collaboration (where international collaboration refers to articles involving the participation of authors of different nationalities; national collaboration refers to articles by authors from different institutions but from the same country; and finally, institutional collaboration refers to articles involving the participation of authors from the same institution) [11]. Additionally, in this section, it is necessary to describe the percentage of academic–corporate collaboration, referring to articles with at least one of its coauthors having an academic affiliation and at least one coauthor having a corporate affiliation, based on the Scopus classification for institutions.

(3) Analysis as per authors' keywords. Visualization maps were created using VOS viewer version 1.6.6 (Leiden University, Leiden, Netherlands) to perform an analysis of co-occurrence of the collaborating countries and keywords. The graphical interpretation is based on the grouping guidelines (keywords) and the distance between countries (co-occurrence networks).

2.5. Ethics

The data was downloaded from public databases; therefore, no ethical approval was obtained.

3. Results

The bibliographic search on CHD (2011–2020) revealed that 8934 articles contained at least one of the keywords used, demonstrating a growing trend in scientific production per year (Fig. 1). The number of authors was 28,706; further, 3663 articles had open access. Additionally, the number of citations obtained for the publications on CHD was 89,835.

The distribution of scientific production at the international level shows that most publications are from the United States (3,015), followed by China and the United Kingdom, with 997 and 711 publications, respectively. The total number of citations obtained was 58,749. European countries with high scientific production on CHD—of over 400 articles—are the United Kingdom, Germany, and Italy. With over 200 publications, Asian countries including China, Japan, and India and Australia have high scientific production. Middle Eastern countries with high scientific production are Turkey and Iran, with over 100 publications. Finally, Brazil, Mexico, and Argentina, with over 50 publications, present high scientific production in Latin America *(Supplementary Material 1)*.

Among the 10 most important institutions *(Table 1)* in terms of scientific production, there is Harvard University, with 427 publications, followed by the University of Toronto and the University of Pennsylvania, with 315 and 256 publications, respectively. From the 10 authors with the highest number of publications of research on CHD (publication of >50 documents), 3 are from Canada, and the rest from other countries.

Among the 20 authors *(Supplementary Material 2),* with high scientific production, Barbara J. M. Mulder has 119 publications, 2970 citations, and an h-index of 76, followed by Dr. Paul Khairy, with 86 publications, 2612 citations, and an h-index of 63.

With regard to the collaboration metrics, national collaboration covers 39.4%, representing the highest percentage, followed by institutional collaboration, with 36.2%. However, although there is growing scientific production, international collaboration represents only 15.1%, and authors' affiliation with academic entities is only 1.0% (Fig. 2).

The percentage of publications on CHD that are found in high-impact (Considered journals belonging to the high category (Q1), which are the best positioned and most cited in their year of publication according to Scimago Scopus) and specialized journals (Considered to those focused on pathologies specific to cardiology) corresponds to 20.9% (1741) (Fig. 3). The most cited article is "Birth Prevalence of Congenital Heart Disease Worldwide: A Systematic Review and Meta-Analysis," with 1356 citations, published in the *Journal of the American College of Cardiology*. The 10 journals *(Table 2),* with the highest number of publications were identified, with the most relevant ones being the *International Journal of Cardiology*, with 300 publications, 4161 citations, and 1464 authors, followed by *Pediatric Cardiology* and *Congenital Heart Disease*, with 273 and 254 publications, respectively. The number and percentage of publications per journal quartile are as follows: quartile Q1 with 3273 (39.3%), Q2 with 2377 (28.6%), Q3 with 1547 (18.6%), and Q4 with 1127 (13.5%) (Fig. 3).

The evaluation of 635 author's keywords were divided into five different groups, where the following terms were highlighted for each: for 1) genetics, "genetical disorders," "transcription factors," and "gene expression"; 2) prenatal and natal stage studies, "maternal exposure," "prenatal exposure," and "prematurity"; 3) studies with epidemiological relationship, "child mortality," "access

Table 1
Top 10 institutions with high scientific production at the international level between the years 2011–2020.

Institution	Sector	Country/Region	Scholarly Output	Citations	Authors	Citations per Publication
Harvard University	Academic	United States	427	9427	535	22.1
University of Toronto	Academic	Canada	315	6486	352	20.6
University of Pennsylvania	Academic	United States	256	5348	376	20.9
Imperial College London	Academic	United Kingdom	252	4454	305	17.7
Stanford University	Academic	United States	180	2613	219	14.5
Cincinnati Children's Hospital Medical Center	Medical	United States	175	2783	157	15.9
University of Amsterdam	Academic	Netherlands	174	3873	141	22.3
Baylor College of Medicine	Academic	United States	174	1945	294	11.2
KU Leuven	Academic	Belgium	157	3277	107	20.9
University of California at Los Angeles	Academic	United States	157	2114	214	13.5

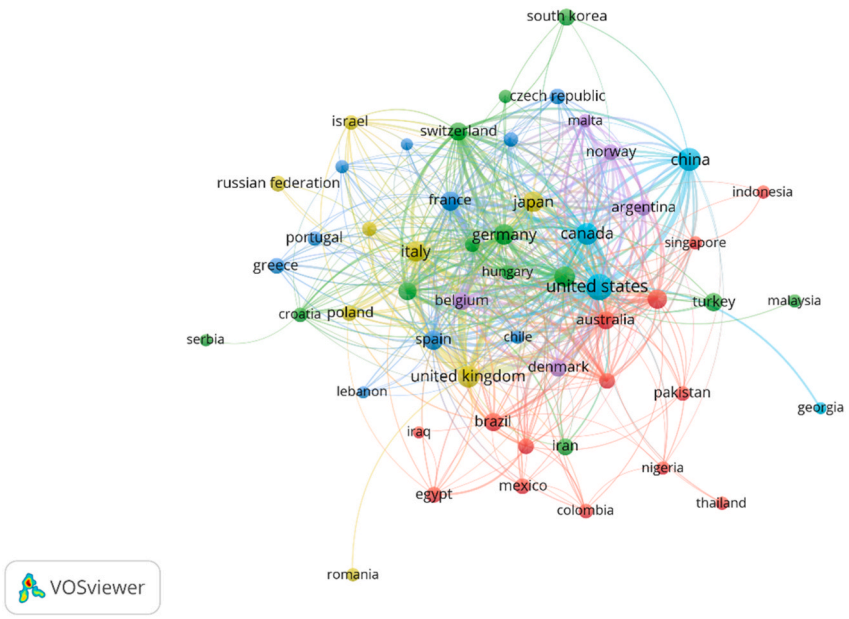


Fig. 2. Collaboration metrics.

to healthcare," and "quality of life"; 4) management and treatment, "vascular access," "anticoagulant agent," and "implantable cardioverter-defibrillator"; and, finally, 5) diagnosis, "electrocardiogram," "imaging diagnosis," or "echocardiography" (Fig. 4).

4. Discussion

In the last 10 years, 8934 articles related to CHD have been developed. Further, a growing trend was observed over time, coinciding with the development of advances that have allowed over 90% of those affected by CHD to survive today. This is because the scientific development on the subject (higher number of articles) has translated into improvements in the areas of prevention, diagnosis, and timely treatment over time [7]. Over 50% of articles belong to developed countries, such as the United States, China, and the United Kingdom, and leading countries in their respective continents, such as Brazil and Turkey, in South America and the Middle East, respectively. These countries share many similarities that may explain their leadership in global scientific production on CHD. A model case can be seen in the United States, a country with a population of over 329 million and an investment per capita of more than 19 million USD (22.5%) for collaborative scientific research and education [12–14]. Regional leadership in scientific production is also attributed to countries considered demographic epicenters of scientific and technological development, such as China, with 1402 billion inhabitants, and Brazil, with 212.6 million [15,16]. However, developing countries that constitute the lower half of the list of top 50 countries with high global scientific production *(Supplementary Material 1)* have less than 70 publications on CHD. Further, they have low percentages of national, international, and institutional collaboration, ranging below 40% during the evaluated period. Previous bibliometric analyses on CHD have already identified the leadership role of the United States and European countries in terms of scientific production, with over 24,000 publications and a mean of 24–41 articles/106 inhabitants (1986–2011). In contrast, in developing countries, around 530 publications are described, with a mean of 1.5 articles/106 inhabitants (1986–2011) [7].

Promoting international collaboration in a research field offers many advantages, including greater citation frequency [17] and more funding opportunities from international agencies [18]. To encourage this, several studies have evaluated the dynamics of such collaboration networks, finding four factors that promote this type of relationship: geopolitical situation, cultural similarities, scientific development, and economic development. In other words, more collaborations occur between countries that are geographically close, that share a language, and that have similar development levels [19]. Thus, more developed countries will prioritize collaborations with countries in similar or better conditions, which would explain why some countries with better indicators of human development show less intention to collaborate with less developed countries [20]. An alternative that can help promote collaboration in these cases is the co-membership in intergovernmental organizations [19], aimed at encouraging scientific development in all the member states.

Research on CHD implies a great investment of economic, technological, and human capital. Promising research initiatives based on molecular principles and requiring solid networks of international collaboration continues to be promoted in pediatric cardiology, especially in developing countries. Meanwhile, higher investment per capita must be promoted and implemented, and a research culture at all educative, social, and academic levels of populations must be encouraged [7,16].

Most developed countries leading global research on CHD are located in North America and have major institutions that generate scientific evidence for CHD, such as Harvard University (USA, 427 publications), followed by the University of Toronto (Canada, 315 publications) and the University of Pennsylvania (USA, 256 publications). All these share the characteristic of having funding sources that come from structural funds, private anonymous entities, and governmental and/or philanthropic organizations. This, together

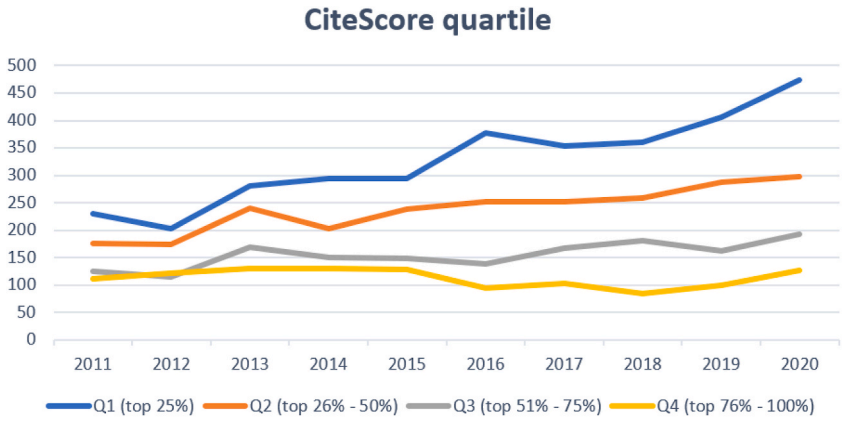


Fig. 3. Journal quartile published per year in the 2011–2020 period.

with a great variety of research programs offered to students beginning the first years of their academic training, has resulted in important scientific contributions, such as in the case of CHD [7]. Unfortunately, institutions from developing countries have not been able to fully implement this work strategy. Consequently, 78% of the global population contributes to only 16% of the global research and scientific development expenses [7,21]. UNESCO reports state that the funds assigned for research and development in developing countries are lower than the global average; therefore, research in these areas are often not innovative and obtain low publication indexes [12,16,22].

When mentioning the role of scientific research institutions in developed countries, the important role of collaborative groups and their principal scientists cannot be ignored. In the case of CHD, during the period evaluated in this study, 28,706 authors participated in the 8934 articles analyzed. Among them, Barbara J.M. Mulder (2970 citations, h-index 76) and Paul Khairy (2612 citations, h-index 63) stand out as the first and second researchers with the highest scientific output worldwide in the field of CHD *(Supplementary Material 2)*.

Although the list of the top 10 journals with high scientific production mainly comprised journals specialized in cardiology and pediatric cardiology, it also included journals specialized in other subjects, such us pediatrics and cardiovascular surgery, as well as multidisciplinary or general journals. Multidisciplinary journals or general biomedical literature tend to be stricter than specialized journals in relation to the quality of the report of their publications. An adequate report of results allows the readers to judge the certainty of the results and to consider the potential risks of bias of each study [23]—this being one of the factors that may explain the different citation patterns of each journal publication. The results also showed that a higher number of citations per publication did not necessarily correspond to a higher quartile journal. For example, one of the journals of quartile 2 (Q2) from the list had more citations per publication than almost all other journals, which were mostly of quartile 1 (Q1). This is probably explained by a limitation inherent to the per quartile classification—that is, the tendency to magnify differences that when analyzing the individual Journal impact factor (JIF) for each journal is insignificant. These arbitrary differences have been detected in up to 30% of journals of the Journal Citation Reports of another database, such as Web of Science [24]. This would explain why a higher quartile journal (higher impact) would not necessarily have more citations per publication than one of a lower quartile.

At the time of analyzing the collaboration metrics in relation to international, national, and institutional collaboration, it must be noted that both national and institutional collaboration accumulate ¾ of the total articles evaluated. In contrast, international collaboration is much less despite the rise in production over the last few years. Additionally, in this study, the percentage of

Table 2
Five journals with high scientific production on coronary heart disease at the international level: citations, authors, and SCImago Journal Rank results between the years 2011 and 2020.

Scopus Source	Publications	Citations	Authors	Citations per Publication	Source-Normalized Impact per Paper (SNIP)	CiteScore 2020	SCImago Journal Rank
International Journal of Cardiology	300	4161	1464	13.9	1.279	6.8	1.406
Pediatric Cardiology	273	2989	1612	10.9	0.963	2.7	0.646
Congenital Heart Disease	254	2944	1419	11.6	1.01	3.4	0.828
Cardiology in the Young	170	1446	853	8.5	0.56	1.5	0.386
Circulation	121	6612	596	54.6	5.281	31.5	7.795
Heart	119	2044	519	17.2	1.861	9	2.184
Journal of Pediatrics	106	1684	767	15.9	1.545	4.8	1.227
Journal of Thoracic and Cardiovascular Surgery	96	1514	442	15.8	1.76	7.4	1.458
PLoS ONE	89	1193	678	13.4	1.349	5.3	0.99
American Journal of Cardiology	88	1667	605	18.9	1.029	4.6	1.394

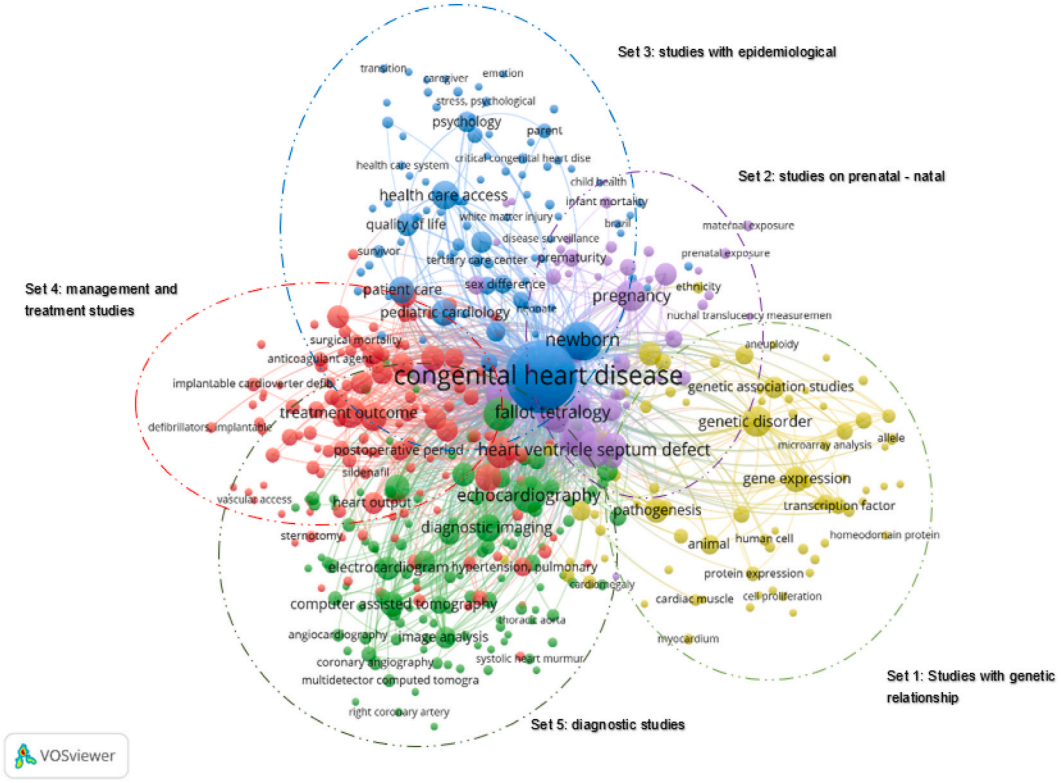


Fig. 4. Author's keywords and research topics.

academic–corporate collaboration occurs only in 1% of the total articles, and the percentage of citations per publication is higher than in articles with academic or corporate affiliation alone. This may be because scientific collaborations between countries to address shared issues contribute to the generation of "international associations as part of the scientific diplomacy," which is currently established [25]. Further, articles with corporate collaboration almost always include many coauthors and, usually, with international affiliations [26]. However, this percentage does not represent all the times a corporate entity participates in any stage of research [11].

Lastly, research areas were found in the authors' keywords map, which were divided into five groups. The keywords most frequently used within these areas were observed. In studies with genetic relationship, the use of "genetic disorder," "gene expression," and "gene association studies" was high, given that in the last few years, genetic studies and advances in heart diseases have increased because of the clinical implications of their findings and the potential to predict and improve results in patients, as 40% of cases of CHD can be detected [27]. In prenatal-natal stage studies, highly used words were "pregnancy," "prematurity," "tetralogy of Fallot," and "septal defect." This may be because the use of assisted reproductive technology has increased during the last years in women older than 30 years, and these pregnancies present a higher risk of CHD, especially the tetralogy of Fallot [28]. In epidemiological studies, the words used were "congenital heart disease," "newly born," "neonate," and "pediatric cardiology," given that CHD is the most common congenital defect affecting millions of newborn babies every year [1], the prevalence of which at the global level was of 1.8 cases per 1000 live births in 2017 [16]. In management and treatment studies, the most used keyword was "treatment result." This is because the surgery for CHD has varied results, given that at 25 years, it has a survival rate of 90%, and most patients survive until adult age, and because the surgical mortality has reduced over time [29]. Finally, in diagnostic studies, the keywords used were "echocardiography," "electrocardiogram," "imaging diagnosis," and "tomography" because an early diagnosis is very important, and CHD can be detected from the prenatal stage. A more complete evaluation can be conducted with a fetal echocardiogram, particularly in high-risk pregnancies [30].

4.1. Limitations and strengths

Limitations include that some articles failed to adequately report their source of funding (if any) or the role such funding had on their research, which would have allowed for conducting an analysis to determine the role and impact of financing institutions in the scientific production. Additionally, the search was conducted on a single database (Scopus), that does not capture studies conducted in Spanish or another language. However, given that Scopus is one of the most complete and representative databases in the world, this study offers a useful approach to the evaluation of the quality and quantity of literature on CHD at the international level. The study provides an analysis that has not been presented in background studies, such as the use of bibliometric indicators of production by institution, author, geographical region, and thematic area.

4.2. Recommendations

The results indicate the need to promote international collaboration by contacting leading authors or research groups at the global level. Specifically, collaboration between less developed countries that show low production should be encouraged, given that information may differ from that of countries with a high sociodemographic index. Further, there is a need to promote greater investment from private institutions and funding from government institutions. Finally, it is important to create lines of research based on the identified areas of interest within the study of CHD.

5. Conclusions

Scientific production has increased in the past years. This process has been led mainly by countries such as the United States, China, and the United Kingdom, and it has been crucial in the improvement of the life expectancy of patients. International and academic–corporate collaborations have been noted in works with higher scientific impact. However, collaboration with less developed countries continues to be low. The researched subjects in the last decade are focused on five fields: genetics, gestation, epidemiology, treatment, and diagnosis.

Author contribution statement

Dr. J. Pierre Zila-Velasque: Dr. Pamela Grados-Espinoza: Dr. W Samir Cubas: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Dr. Mario Diaz-Barrera: Josmel Pacheco-Mendoza: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e19188.

References

[1] Y. Liu, S. Chen, L. Zühlke, et al., Global birth prevalence of congenital heart defects 1970–2017: updated systematic review and meta-analysis of 260 studies, Int. J. Epidemiol. 48 (2) (2019) 455–463, https://doi.org/10.1093/ije/dyz009.
[2] E.B. Stallings, J.L. Isenburg, D. Aggarwal, et al., Prevalence of critical congenital heart defects and selected co-occurring congenital anomalies, 2014-2018: a U. S. population-based study, Birth Defects Res 114 (2) (2022) 45–56, https://doi.org/10.1002/bdr2.1980.
[3] Z. Yu, D. Li, L. Sun, et al., Long-term trends in the incidence of congenital anomalies in Central China from 1997 to 2019, Publ. Health 203 (2022) 47–52, https://doi.org/10.1016/j.puhe.2021.12.007.
[4] Z. Su, Z. Zou, S.I. Hay, et al., Global, regional, and national time trends in mortality for congenital heart disease, 1990–2019: An age-period-cohort analysis for the Global Burden of Disease 2019 study, eClinicalMedicine (2022) 43, https://doi.org/10.1016/j.eclinm.2021.101249.
[5] C.I. Tchervenkov, J.P. Jacobs, P.L. Bernier, et al., The improvement of care for paediatric and congenital cardiac disease across the World: a challenge for the World Society for Pediatric and Congenital Heart Surgery, Cardiol. Young 18 (Suppl 2) (2008) 63–69, https://doi.org/10.1017/S1047951108002801.
[6] NCD Countdown 2030 collaborators, NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4, Lancet Lond. Engl. 392 (10152) (2018) 1072–1088, https://doi.org/10.1016/S0140-6736(18)31992-5.
[7] T. Farhat, Z. Abdul-Sater, M. Obeid, et al., Research in congenital heart disease: a comparative bibliometric analysis between developing and developed countries, Pediatr. Cardiol. 34 (2) (2013) 375–382, https://doi.org/10.1007/s00246-012-0466-6.
[8] M.I. Orwat, A. Kempny, U. Bauer, M.A. Gatzoulis, H. Baumgartner, G.P. Diller, The importance of national and international collaboration in adult congenital heart disease: a network analysis of research output, Int. J. Cardiol. 195 (2015) 155–162, https://doi.org/10.1016/j.ijcard.2015.05.116.
[9] M.E. Falagas, E.I. Pitsouni, G.A. Malietzis, G. Pappas, Comparison of PubMed, Scopus, Web of science, and Google scholar: strengths and weaknesses, FASEB J. Off. Publ. Fed. Am. Soc. Exp. Biol. 22 (2) (2008) 338–342, https://doi.org/10.1096/fj.07-9492LSF.
[10] R. Dresbeck, SciVal. J Med Libr Assoc JMLA. 103 (3) (2015) 164–166, https://doi.org/10.3163/1536-5050.103.3.018.
[11] J.A. Arévalo, Research Metrics Guidebook: un complemento sencillo y práctico para el uso de herramientas como Scopus y SciVal, Universo Abierto (2021). Published May 17, https://universoabierto.org/2021/05/17/research-metrics-guidebook-un-complemento-sencillo-y-practico-para-el-uso-de-herramientas-como-scopus-y-scival/. (Accessed 18 December 2021).
[12] J. Van den Eynde, T. Franchi, Y.C. Foo, et al., The 100 most influential articles in congenital heart disease in 2000–2020: a bibliometric analysis, Int. J. Cardiol. Congenit. Heart Dis. 4 (2021), 100156, https://doi.org/10.1016/j.ijcchd.2021.100156.
[13] Y. Yang, T. Greaney, Economic growth and income inequality in the Asia-Pacific region: a comparative study of China, Japan, South Korea, and the United States, J. Asian Econ. 48 (C) (2017) 6–22.

[14] W. Shuaib, M.S. Khan, H. Shahid, E.A. Valdes, R. Alweis, Bibliometric analysis of the top 100 cited cardiovascular articles, Am. J. Cardiol. 115 (7) (2015) 972–981, https://doi.org/10.1016/j.amjcard.2015.01.029.
[15] J.L. Oreiro, L.L. Manarin, P. Gala, Deindustrialization, economic complexity and exchange rate overvaluation: the case of Brazil (1998-2017), PSL Q. Rev. 73 (295) (2020) 313–341, https://doi.org/10.13133/2037-3643_73.295_3.
[16] GBD 2017 Congenital Heart Disease Collaborators, Global, regional, and national burden of congenital heart disease, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017, Lancet Child Adolesc. Health 4 (3) (2020) 185–200, https://doi.org/10.1016/S2352-4642(19)30402-X.
[17] C de Lima, B.S.R. Paiva, dos S. Neto Mf, et al., The impact of international research collaborations on the citation metrics and the scientific potential of South American palliative care research: bibliometric analysis, Ann. Glob. Health 87 (1) (2021) 32, https://doi.org/10.5334/aogh.3158.
[18] C. McManus, A.A. Baeta Neves, A.Q. Maranhão, A.G. Souza Filho, J.M. Santana, International collaboration in Brazilian science: financing and impact, Scientometrics 125 (3) (2020) 2745–2772, https://doi.org/10.1007/s11192-020-03728-7.
[19] L. Hou, Y. Pan, J.J.H. Zhu, Impact of scientific, economic, geopolitical, and cultural factors on international research collaboration, J. Informetr. 15 (3) (2021), 101194, https://doi.org/10.1016/j.joi.2021.101194.
[20] S. AL-Aqeel, A.M. Mendes, H. Taisir, F. Fernandez-Llimos, International collaboration in pharmacy practice research: a bibliometric analysis, Res. Soc. Adm. Pharm. 16 (11) (2020) 1513–1518, https://doi.org/10.1016/j.sapharm.2020.05.019.
[21] M. Mazboudi, A. Ben Abdelaziz, Medical research productivity of Lebanon: a bibliometric study of papers indexed in Medline, 1985-2004, Tunis. Med. 88 (8) (2010) 579–585.
[22] Q. Wang, F. Zhang, Does increasing investment in research and development promote economic growth decoupling from carbon emission growth? An empirical analysis of BRICS countries, J. Clean. Prod. 252 (2020), 119853, https://doi.org/10.1016/j.jclepro.2019.119853.
[23] M.J. To, J. Jones, M. Emara, A.R. Jadad, Are reports of randomized controlled trials improving over time? A systematic review of 284 articles published in high-impact general and specialized medical journals, PLoS One 8 (12) (2013), e84779, https://doi.org/10.1371/journal.pone.0084779.
[24] G.A. Vîiu, M. Păunescu, The lack of meaningful boundary differences between journal impact factor quartiles undermines their independent use in research evaluation, Scientometrics 126 (2) (2021) 1495–1525, https://doi.org/10.1007/s11192-020-03801-1.
[25] S. López-Vergès, B. Urbani, D. Fernández Rivas, et al., Mitigating losses: how scientific organisations can help address the impact of the COVID-19 pandemic on early-career researchers, Humanit. Soc. Sci. Commun. 8 (1) (2021) 284, https://doi.org/10.1057/s41599-021-00944-1.
[26] H. Pohl, Internationalisation, innovation, and academic–corporate co-publications, Scientometrics 126 (2) (2021) 1329–1358, https://doi.org/10.1007/s11192-020-03799-6.
[27] J. Yasuhara, V. Garg, Genetics of congenital heart disease: a narrative review of recent advances and clinical implications, Transl. Pediatr. 10 (9) (2021) 2366–2386, https://doi.org/10.21037/tp-21-297.
[28] A. Galdini, V.M.E. Fesslova, G. Gaeta, et al., Prevalence of congenital heart defects in pregnancies conceived by assisted reproductive technology: a cohort study, J. Clin. Med. 10 (22) (2021) 5363, https://doi.org/10.3390/jcm10225363.
[29] L.G. Spector, J.S. Menk, J.H. Knight, et al., Trends in long-term mortality after congenital heart surgery, J. Am. Coll. Cardiol. 71 (21) (2018) 2434–2446, https://doi.org/10.1016/j.jacc.2018.03.491.
[30] P. Rajiah, C. Mak, T.J. Dubinksy, M. Dighe, Ultrasound of fetal cardiac anomalies, AJR Am. J. Roentgenol. 197 (4) (2011) W747–W760, https://doi.org/10.2214/AJR.10.7287.