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Research on Neonatal Conditions in Africa: Funding Activities from a Bibliometric Perspective

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Abstract: The literature has shown that neonatal deaths contribute largely to the total number of deaths in children under 5 years of age worldwide and that 39% of all neonatal deaths recorded in 2019 were in Africa. Neonatal conditions (NCs) are the main cause of these losses. Therefore, NC research is critical to improve the ability to prevent, predict, detect, treat, and manage neonatal problems. However, this research must be properly funded to arrive at outcomes of interest. Regarding the funding of NC research, no study has addressed this issue. In this regard, a bibliometric analysis of the funding information reported in publications can assist scientists in seeking funds for ongoing or new NC research and those involved in developing and implementing strategies to improve NC funding. Using a bibliometric analysis, this study identified the African and non-African funders mentioned in articles on NC research in Africa published between 1990 and 2019. A set of indicators gives an initial picture of funding activities. The results show that the involvement of African and non-African funders in NC research has increased; NC research is highly dependent on foreign funders, especially from the United States of America (USA) and the United Kingdom (UK); and the funding comes from few funders. Strategies are necessary to reduce the fragility of the funding structure of NC research due to its high dependence on foreign funders and concentration on few funders.

Keywords: Africa; neonatal conditions; bibliometrics; collaboration; funding; non-communicable diseases; public health

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1. Introduction

The analysis of the number of neonatal deaths or DALYs (a measure of the total burden of disease, expressed as the number of years lost due to illness, disability, or early death) is essential as input to design and implement strategies to improve neonatal health. The literature has looked at both aspects and has come to the conclusion that a call for urgent action worldwide is needed.

Several studies have examined under-5 mortality (U5M) estimates at global, regional, and country levels (Black et al., 2010; Liu et al., 2012; Sharrow et al., 2022; Wang et al., 2014; You et al., 2015) to assess progress towards child survival goals. It has been found that deaths in this cohort decreased by 58% globally and by 30% in Africa from 1990 to 2019 (Sharrow et al., 2022). In addition, the number of deaths is regionally concentrated, with Africa, in general, accounting for 35% and sub-Saharan Africa for 31% of total deaths in 1990 (only South Asia has a higher percentage, 38%). Despite the decline in deaths in these

regions, their representativeness of under-5 deaths in the total World increased to 59% for Africa and 55% for sub-Saharan Africa in 2019 (Sharrow et al., 2022).

The breakdown of data has shown that in 1990, neonatal deaths accounted for 40% of under-5 deaths at the World level, and this percentage increased to 47% in 2019 (Sharrow et al., 2022). In Africa, neonatal deaths accounted for 29% of under-5 deaths in 1990 and 39% in 2019, an increase that mirrors the highest decline in other causes of death of U5M on the continent.

Using the number of DALYs, it has been shown that NCs were responsible for 32% of all DALYs for children younger than 5 years in 2000 at the World level. This value increased to 38% in 2019, despite the DALYs decreasing between these years. Regarding Africa, this cause was responsible for 23% of all DALYs for African children younger than 5 years in 2000, and for 32% in 2019. Also, Africa accounted for 28% of all DALYs in the World due to NCs in 2000 and 43% in 2019 (WHO, 2020).

The results obtained emphasize the need for neonatal health strategies. Given that NCs are responsible for a significant number of deaths, research on this topic is essential to improve the ability to prevent, predict, detect, treat, and manage neonatal problems. Therefore, this research must be adequately funded to achieve results that meet local needs. The literature on funding has addressed prenatal and neonatal health, newborn health, stillbirths, and neonatal infections (e.g., Agravat et al., 2023; Confraria & Wang, 2020; Kebede et al., 2014; Kumar et al., 2023; Pitt et al., 2017; Seale et al., 2015). To our knowledge, the funding of NC research in Africa has not yet been investigated.

Understanding the funding patterns of a particular sector can be a challenge if there are no infrastructures archiving these activities. World RePORT is an example of a platform that brings together funding data from fourteen member institutions in biomedical research. In Africa, these infrastructures are underdeveloped, which makes analyzing funding patterns a major challenge. This is where bibliometrics can play an important role by providing an initial picture of funding patterns.

Bibliometrics enables a meaningful analysis of a "body" (country, institutions, journals, scientific field, and/or individuals) based on the metadata of publications (Confraria & Wang, 2020). A number of indicators (so-called bibliometric indicators) have been developed (Nwaka et al., 2012), that allow a description of scientific performance and highlight strengths, weaknesses, opportunities, and threats. They have been applied, for example, in the context of countries (European Innovation Scoreboard, UNESCO Science Reports), institutions (SCImago Institutions Rankings, CWTS Leiden Ranking), and journals (SCImago Journal & Country Rank, CWTS Journal Indicators). The growth of bibliometrics as a field of research has been remarkable in recent decades, mainly due to the new technical possibilities offered by computer tools. Bibliometric indicators have several advantages that make them attractive: (1) they can be used to evaluate a large number of documents, (2) they allow for simple and objective information on scientific performance, (3) they are relatively inexpensive to collect and easy to implement compared to other tools with a similar objective (peer review evaluation), (4) they allow for measuring the multidimensional nature of research activities, and (5) they are easily understood by the community, even though they are criticized by many.

Considering the attractiveness of this method, we conducted a bibliometric analysis to examine the funding information in articles dealing with NCs. Bibliometric analysis has already been applied to funding information in publications to understand the impact of funding agencies on scientific research (AUDA-NEPAD, 2019; Head et al., 2017; Pereira & Confraria, 2022; Stefanoudis et al., 2021) and collaboration (Head et al., 2017), as well as the funding structure of regions.

In this way, we show the participation of African and non-African countries/institutions in funding activities globally and by type of collaboration. Based on these findings, we point out the implications from the perspective of scientists seeking funding for ongoing or new NC research and policy makers pursuing strategies to improve NC funding. In short, this study (1) provides an initial picture of NC research funding in Africa while pointing out the limitations of the methodology, and (2) highlights the usefulness of bibliometrics in this context.

This paper is organized as follows: the next section describes the methodology, the Results and Discussion section presents the results of the funding analysis and discusses its implications, and the Conclusions section highlights the main findings.

2. Data and Methods

2.1. Data

We searched for various terms related to NCs validated by the peers in the research conducted by Confraria and colleagues (Confraria & Wang, 2020) in titles, abstracts, and keywords of articles in the Web of Science Core Collection (WoS) published between 2000 and 2019 (all languages and the indexes Science Citation Index Expanded (SCI-since 1990), Social Sciences Citation Index (SSCI-since 1956), Arts & Humanities Citation Index (AHCI-since 1975), Emerging Sources Citation Index (ESCI-since 2020), Conference Proceedings Citation Index-Science (CPCI-S), and Conference Proceedings Citation Index-Social Science & Humanities (CPCI-SSH-both since 1990) were considered).

This study is the third in a series of studies dealing with NCs in Africa (the previous were related to volume, impact, themes, and research collaboration). For the reader to have a comprehensive analysis of the topic, we decided to use the same period of analysis as in the previous studies.

We obtained the metadata for 1784 articles (Figure 1) in which at least one scientist (not all authors of a publication are scientists in the strict sense of the word, but for the sake of simplicity, we use this word to refer to the authors) works at an institution in Africa (hereafter African scientists).

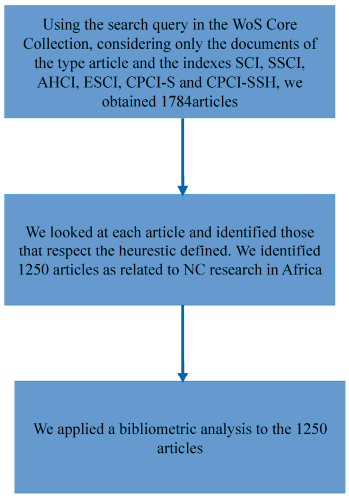

Figure 1. Flow chart of the article selection process.

The search query used to obtain the publications from the WoS Core Collection is as follows:

((ts = "Preterm birth" OR ts = "Birth asphyxia" OR ts = "birth trauma" OR ts = "Neonatal sepsis" OR tss = "neonatal infection*" OR ts = "Gastroschisis" OR ts = "Jaundice" OR ts = "Necrotizing enterocolitis" OR ts = "Persistent pulmonary hy-

pertension of the newborn" OR ts = "Intrauterine growth restriction" OR ts = "Bronchopulmonary dysplasia" OR ts = "infant apnoea" OR ts = "infant respiratory distress syndrome" OR ts = "asphyxia at birth" OR ts = "anaemia in neonates" OR ts = "neonatal alloimmune thrombocytopenia" OR ts = "bronchopulmonary dysplasia" OR ts = "cardiac failure in neonates" OR ts = "hyaline membrane disease" OR ts = "hypocalcaemia in neonates" OR ts = "hypoglycaemia of the newborn" OR ts = "hyponatraemia in neonates" OR ts = "hypothermia in neonates" OR ts = "intestinal obstruction in neonates" OR ts = "pulmonar interstitial emphysema") and (cu = "South Africa" OR cu = "Egypt" OR cu = "Nigeria" OR cu = "Ethiopia" OR cu = " Rep Congo" OR cu = "Dem Rep Congo" OR cu = "Tanzania" OR cu = "Kenya" OR cu = "Algeria" OR cu = "Sudan" OR cu = "South Sudan" OR cu = "Morocco" OR cu = "Uganda" OR cu = "Mozambique" OR cu = "Ghana" OR cu = "Angola" OR cu = "Somalia" OR cu = "Ivory Coast" OR cu = "Cote Ivoire" OR cu = "Madagascar" OR cu = "Cameroon" OR cu = "Burkina Faso" OR cu = "Niger" OR cu = "Malawi" OR cu = "Zambia" OR cu = "Mali" OR cu = "Senegal" OR cu = "Zimbabwe" OR cu = "Chad" OR cu = "Tunisia" OR cu = "Guinea" OR cu = "Guinea Bissau" OR cu = "Equat Guinea" OR cu = "Rwanda" OR cu = " Benin" OR cu = "Burundi" OR cu = "Eritrea" OR cu = "Sierra Leone" OR cu = "Togo" OR cu = "Libya" OR cu = "Cent Afr Republ" OR cu = "Mauritania" OR cu = "Liberia" OR cu = "Namibia" OR cu = "Botswana" OR cu = "Lesotho" OR cu = "Gambia" OR cu = "Gabon" OR cu = "Mauritius" OR cu = "Eswatini" OR cu = "Swaziland" OR cu = "Djibouti" OR cu = "Comoros" OR cu = "Cape Verde" OR cu = " Sao Tome & Prin" OR cu = "Seychelles") and py = 2000–2019).

Due to the limitations of using discipline-specific terms, we analyzed each article and selected those addressing NC research in Africa. In the 1250 articles retained, we aimed to find:

- articles addressing different conditions;
- articles that compile statistics at the global level and specifically for Africa on causes of death and NCs, and
- articles that, in studies conducting a meta-analysis, are the reported clinical trials conducted in Africa or other population samples with Africans.

2.2. Funding Identification and Bibliometric Analysis

As for funding, we extracted the information from the "Funding Orgs" and "Funding Text" fields available in the WoS, identified the organization, and searched for the country in which it was based. Since the WoS only provides information on the funding of articles published from 2008 onwards, we extracted the funding information from the full texts of the earlier articles.

As for funding, we followed the following heuristics:

- We considered funding to be the financial support, through various types of grants, publication fees, funding for online infrastructure, funding for reagents and other materials, and funding for mobility.
- If the information in the "Funding Orgs" did not match that in the "Funding Text", we made the necessary corrections.
- In an article acknowledging funding from an organization with branches in several countries, if the country was not mentioned, we considered the country where the headquarters is located.
- In an article acknowledging a partnership funded by multiple organizations, we considered the hosting country. For example, The Partnership for Maternal, Newborn & Child Health (PMNCH) is hosted by the World Health Organization (WHO), based in Geneva, Switzerland, and has received funding from the Bill & Melinda

Gates Foundation, the Children's Investment Fund Foundation, Johnson & Johnson, and others.

- As for public funding institutions of a country, we maintained the distinction between thematic agencies (e.g., research funding agency, agency for international development).

Here, we assume that the sample of articles with funding information provides a good representation of the funding activities of NC research globally and over time, despite the methodological limitations (see the limitations below).

After cleaning the data and identifying the funding organizations, we obtained a set of bibliometric indicators:

- We determined the number of articles with funding information and included a longitudinal perspective.
- We analyzed the geographical dispersion of funding activities and highlighted the main funders (countries/institutions).
- We analyzed the funding activities for the different types of collaborations.
- We analyzed co-funding activities.

As for collaboration, we followed the following heuristics:

- Using the author's affiliation(s) in the articles, we extracted information concerning the country and universities.
- We only considered institutions designated universities, given that universities are the main players in the discovery and creation of knowledge and ideas.
- For universities, we aggregated the information at the higher level of the organization (e.g., information is not available for departments or individual faculties belonging to a given university). In the case of the USA, the results are presented for the university system and not for the individual campuses. For example, the University of California is a university system composed of ten campuses located in different regions. All the articles mentioning the different campuses of the university were considered as University of California.
- As for international research collaboration (IRC), we identified the articles that have at least two authors whose affiliations mention institutions located in two countries. Once the articles with IRC were identified, we analyzed them with more detail and identified occurrences between: (1) African scientists all from the same country and non-African scientists (IRC_{inter}); (2) only African scientists from different countries (IRC_{intra}); and (3) African scientists from different countries and non-African scientists ($IRC_{inter\text{-}intra}$).
- Concerning DRC, we considered articles that only represent collaborations between scientists working in the same or different institutions in each African country.

2.3. Limitations

As for the method used to extract articles on NC, the less positive points must be emphasized.

Non-African scientists, mainly those from high-income countries (HICs), might conduct research on NCs in Africa without the participation of African scientists, a phenomenon known in the literature as parachute science (e.g., Stefanoudis et al., 2021). However, we should emphasize the results from the literature of the research performed by scientists from HICs on the greatest burden of disease. Most of the research on Medical and Health Sciences (M&HS), which includes NCs, has been performed by HICs and have addressed their local scientific problems, which are very different from those of Africa (Atal et al., 2018; Evans et al., 2014). As for neonatal disorders, results have shown that

disease-specific gaps exist in sub-Saharan Africa (Atal et al., 2018) and that the burden is very prevalent in Africa in general (Ou et al., 2022).

In M&HS, research involving African and non-African scientists has shown that while 67% of the total 520 clinical trials conducted in Africa addressed local scientific problems, in 14% of cases, the research addressed the needs of developed countries. Therefore, we cannot guarantee that all the NC research identified is related to local needs in Africa.

As for the chosen database, we need to mention the main differences between the WoS, Scopus, and Dimensions. The WoS's selection approach to index sources is more selective than that of Scopus or Dimensions; therefore, the number of indexed publications is lower than in Scopus or Dimensions (Mongeon & Paul-Hus, 2016; Singh et al., 2021; Visser et al., 2021). Consequently, the choice, which was based on the availability of the InCites platform in our institution, is a limitation, as we may not have considered all possible publications.

Additionally, it is relevant to mention the differences regarding the coverage of sources by region. The extant literature has shown that African journal are under-represented in the WoS compared to journals from other regions, mainly Europe and North America (Asubiaro et al., 2024). Taking into account that African scientists may choose to publish in African and non-African journals, this under-representation should be considered by the readers.

When analyzing funding, it is important to consider that some publications may not include information on funding because of the following: (1) the research was not funded, or (2) the scientists involved in the research did not provide information on funding activities. Moreover, the results presented only provide information on the participation of the organizations and not on the amount of funding. Finally, regarding the publications from 2008 onwards, we have used the information provided by the WoS. Here we need to consider the performance of the database regarding the accuracy of the information provided (e.g., Grassano et al., 2017). We identified and corrected the differences between the two columns (Funding Orgs and Funding Text) where funding information can be obtained from the WoS. However, there may be situations where funding is not indicated in the WoS but is indicated in the publication (Grassano et al., 2017). The opposite might also be the case. Also, we need to consider the discrepancies of the WoS regarding the language coverage of funding information (Grassano et al., 2017). WoS coverage is higher for funding in English.

3. Results and Discussion

3.1. Funding—A Global Perspective

The number of articles on NCs increased from 15 in 2000 to 196 in 2019 (Figure 2A), as did the number of articles mentioning funding (Figure 2B). Of the total 611 articles mentioning funding, 5 articles were published in 2000 and 105 in 2019. The highest number of articles can be observed in 2015–2019 (Figure 2C). During this period, 374 articles with funding information were published. The relative weight of articles with funding increased between 2000–2004 and 2015–2019 (publication year), but the pattern is far from linear. There are two moments when the number of articles increased but their representativeness decreased (between 2000–2004 and 2005–2009, and 2010–2014 and 2015–2019). In 2015–2019, funding was recognized in about 50% of articles, compared to 44% in 2000–2004 (Figure 2C).

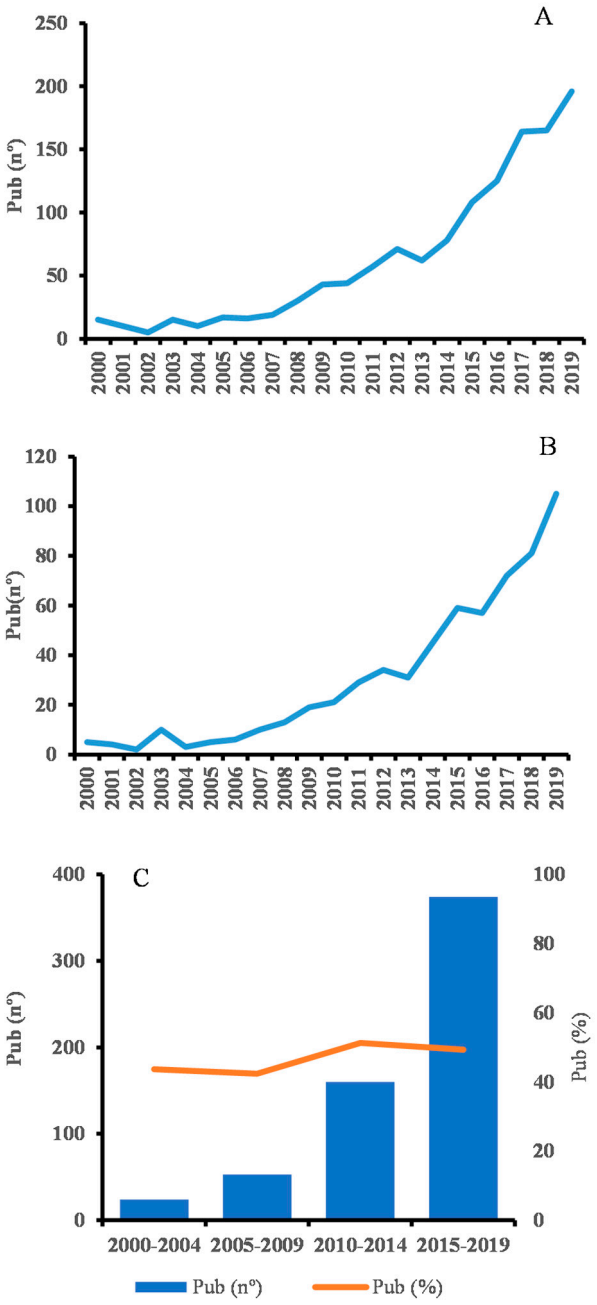

Figure 2. Number of articles on NCs (**A**), acknowledging the funding sources (**B**) and their representativeness given the total number of articles published in each period (**C**).

The results can be interpreted in two main ways. On the one hand, if we assume that the higher the number of papers with funding information, the higher the available funding, then the results suggest that NC research attracted the attention of the funders. On the other hand, part of the observed increase may be because funders have introduced formal requirements for disclosure of funding in publications. It is impossible to determine the predominant phenomena empirically, but we believe that the recognition of the importance of research funding by funders is predominant.

A third justification may be the increase in the number of publications that have occurred in the WoS Core Collection over time (van de Sompel, 2024).

3.2. Funding from African and Non-African Regions

The results indicate that Africa has limitations concerning the funding of NC research, as only a quarter of publications (154 out of 611) reporting funding refer to African-based institutions (SI, Table S2). This is consistent with the observations made by (Nwaka et al., 2012) in their analysis of pan-African centers of excellence in health innovation. The authors found that internal funding accounted for 32% of all funding in 2010. This suggests that funding limitations are present in several health fields.

Apparently, there is a considerable number of countries that do not invest in NC research, as institutions in only 21 of the 41 African countries researching NC were identified (SI, Tables S1 and S2). The geographical distribution of African funders is asymmetrical, as most articles refer to institutions in South Africa and Ethiopia (52 and 35 articles, respectively, 8% and 6% of all articles reporting on funders, Figure 3).

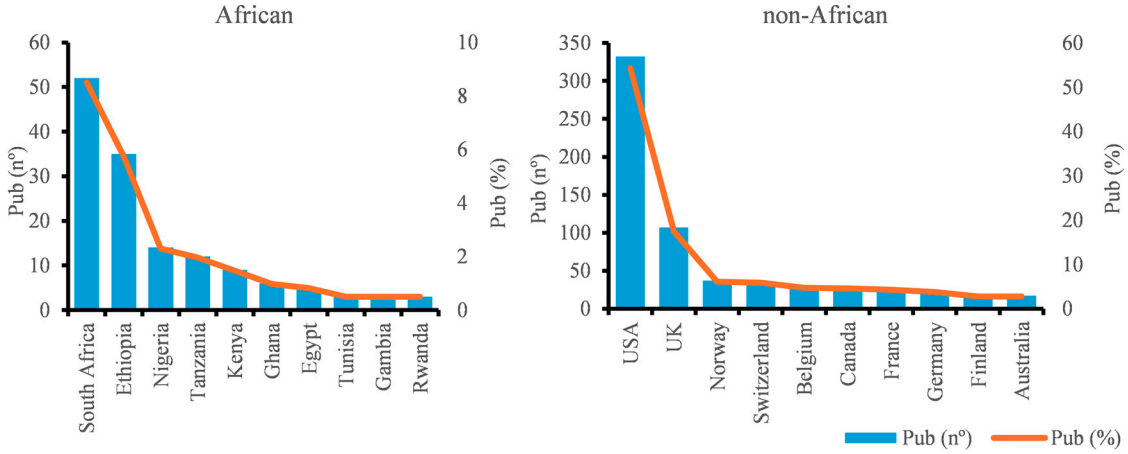

Figure 3. The number of articles acknowledging the funding source, between 2000 and 2019, considering the country where the source is located and its representativeness given the total number of articles with funding. Only the top 10 countries are shown.

This low participation is in line with observations presented elsewhere, which underline the low Gross Domestic Expenditure on Research and Development of the African countries of less than 1% of the Gross Domestic Product (AUDA-NEPAD, 2019). South Africa and Ethiopia have the highest figures, 0.70% and 0.64% of GDP, respectively, and the main sources of funding are the government sector, in addition to the business sector in the case of South Africa (AUDA-NEPAD, 2019).

From a longitudinal perspective, the number of African countries investing in NC research increased from four to sixteen (SI, Table S2). However, the actual reason for this increase cannot be identified. The recognition of the importance of investing in research may be the main explanation, but the commitment to provide credit to funders cannot be discarded.

The low participation of African countries in funding activities does not reveal a clear pattern for each country over time. In each period, South Africa stands out, although it is surpassed by Ethiopia in one article, in 2015–2019. This suggests that a different pattern may emerge in the future (SI, Table S2). The preeminent position of South Africa was also observed in (Nwaka et al., 2012) in their analysis of the pan-African centers of excellence in health innovation.

The geographical dispersion of funding from non-African countries is greater than that from African countries, as institutions from 38 countries were identified (SI, Table S3). Non-African countries can be considered the main funders of NC research in Africa, as they are mentioned in 85% of all articles with funding information. This suggests a strong

dependence on foreign funding, even if the amounts invested are unknown. The dominance of foreign funding has also been noted in health research spending in sub-Saharan Africa (Kebede et al., 2014) and in the funding of pan-African centers of excellence for health innovation (Nwaka et al., 2012).

The geographical distribution of foreign funding is also asymmetrical, with a high number of articles mentioning institutions in the USA and the UK (332 and 107 articles, respectively, Figure 3). It appears that this is the normal pattern in Africa, as the same behavior has been observed in other studies on health (Head et al., 2017; Nwaka et al., 2012).

Other scientific powers also appear in the top 10 according to the number of articles in which they are mentioned as funders. Norway and Canada are examples of this, albeit with a small number of articles. Regarding Switzerland and Belgium, the WHO and the European Research Executive Agency (REA, the funding body of the European Commission) are mentioned in around 50% of the articles with funding information.

Over time, the results suggest that NC research has attracted the interest of foreign funders, as the number of funding countries has increased, eight in the period from 2000–2004 and 34 in the period from 2015–2019 (SI, Table S3). Throughout the periods, the USA and the UK are the most represented in each period, albeit with very different contributions (SI, Table S3). Interestingly, the USA participation is less representative in 2015–2019 compared to 2010–2014, although the number of articles mentioning this country increased. In 2010–2014, the USA is mentioned in 63% of all articles, and in 2015–2019 in 50%. This means that other countries could play an important role in funding research on NCs in Africa in the future.

The African countries that produced the most publications on NCs (SI, Table S1) are those that appear the most as funders. As for Egypt, although it has the highest number of articles on NCs, the results suggest that Egypt is not investing in NC research, as only five articles mention institutions in this country (SI, Table S2). Regarding non-African countries, the USA and the UK contributed the most to NC research (SI, Table S13) and are the main funders.

Co-funding activities are not frequent, as only a small proportion of research was funded by African and non-African countries simultaneously, namely 64 articles (10% of all articles with funding information) over the entire period (Figure 4). However, it appears that funders are recognizing the importance of working together to solve problems in Africa, as co-funding activities are generally increasing. Funding that comes exclusively from non-African institutions is the most widespread. They are mentioned in about 75% of all articles with funding information in 2000–2019, underlining the high dependence on foreign funding mentioned previously.

As far as funding from Africa alone is concerned, the small number of articles, even if it has increased over time, confirms the earlier argument of financial inability to invest in problems that largely affect the continent.

Research on NCs in Africa was funded by 479 institutions (SI, Table S4). The geographical distribution of institutions is highly skewed, with approximately 26% of institutions located in the USA and 10% in the UK (Figure 5). The presence of African countries in the top 10 in terms of number of institutions is low, with only Ethiopia and South Africa represented.

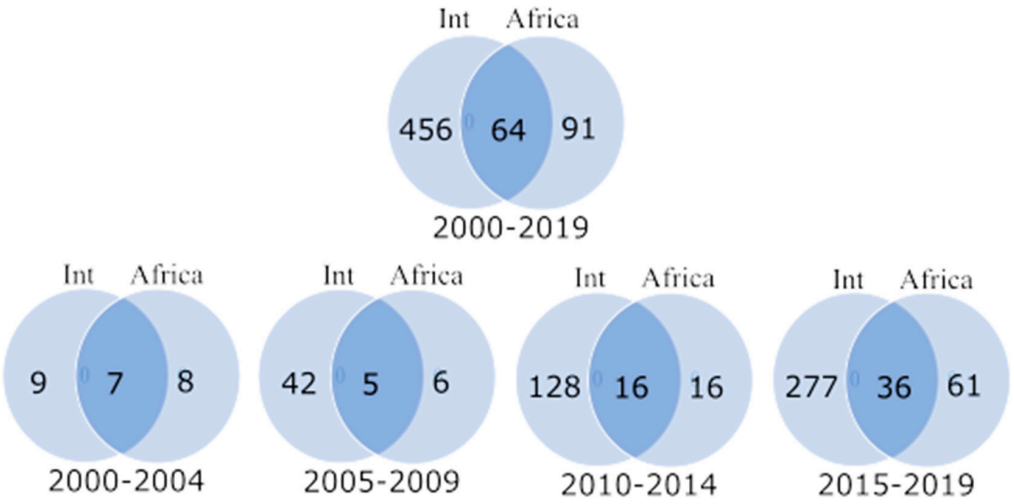

Figure 4. The number of articles acknowledging only non-African (Int), only African, and both African and non-African funding sources.

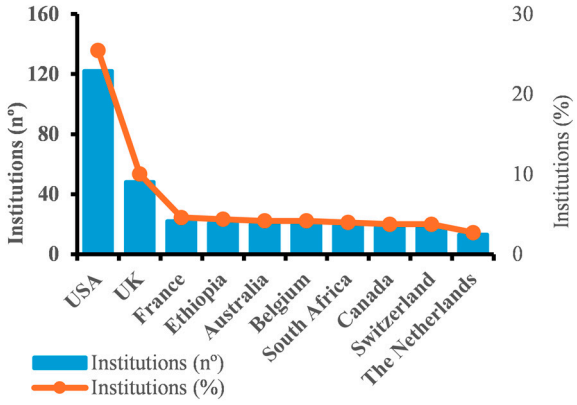

Figure 5. The top 10 funding countries, given the number of institutions acknowledged as funding sources, over the whole studied period.

From a global perspective, the results suggest that the majority of funding comes from a few institutions, as the distribution of articles by source is very skewed (SI, Table S4), with few institutions being mentioned in many articles. The institutions in the top 10 appear in about 55% of the articles acknowledging funding, and 301 institutions (about 63% of all institutions) were mentioned in only one article (SI, Table S4). This top group is made up almost exclusively of non-African institutions. The Medical Research Council (SA-MRC) and the National Research Foundation (NRF) from South Africa are the only African institutions.

Regarding the individual regions, only 97 African institutions were identified (SI, Table S4). It appears that in Africa, the SA-MRC and NRF pave the way for investment in NC research, as they are mentioned in 33 and 19 of the 154 articles acknowledging funding from Africa, respectively (Figure 6). A total of 40% of the identified African institutions are mentioned in one article in 20 years (62 institutions, SI, Table S4). The top 10 also includes institutions from Ethiopia, Nigeria, and Kenya, albeit with lower participation than SA-MRC and NRF (Figure 6). Together with the SA-MRC and NRF, these institutions are represented in 44% of all articles in which funding from Africa is mentioned.

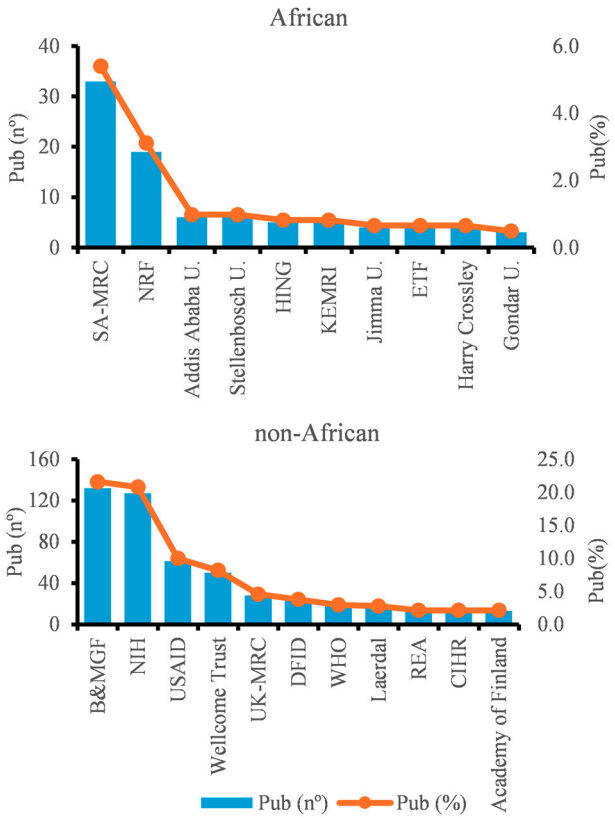

Figure 6. The top 10 institutions, according to the number of articles where they are mentioned as funding sources, by region (African and non-African) and representativeness in the total number of articles acknowledging funding.

As for the non-African region, the results show that research on NCs is highly dependent on funding from Bill & Melinda Gates (B&MGF) and the National Institutes of Health (NIH), as these institutions stand out among the top 10 institutions by the number of articles in which they are mentioned (Figure 6). They are mentioned in about 1/5 (every) of all articles with funding information (Figure 6). The same pattern has been found in other studies (Head et al., 2017; Nwaka et al., 2012; Pereira & Confraria, 2022). The top 10, as in the case of the African region, also suggest that the origin of funding lies in a small number of institutions, as they are mentioned in 65% of the articles mentioning funding from non-Africa.

3.3. Funding and Collaboration

Research with scientists from multiple countries, i.e., with international research collaboration (IRC), benefits very little from African investment, as African institutions are barely mentioned when looking at the top 10 institutions (only the SA-MRC appears in the top 10 for research with African scientists, all from the same country, and non-African scientists (IRCinter)) (Figure 7, SI, Table S11 for the number of articles with IRC and funding). In articles with IRC, only 49 African institutions are identified as funders (SI, Table S6), and they are acknowledged in 12% of articles with IRC and funding information.

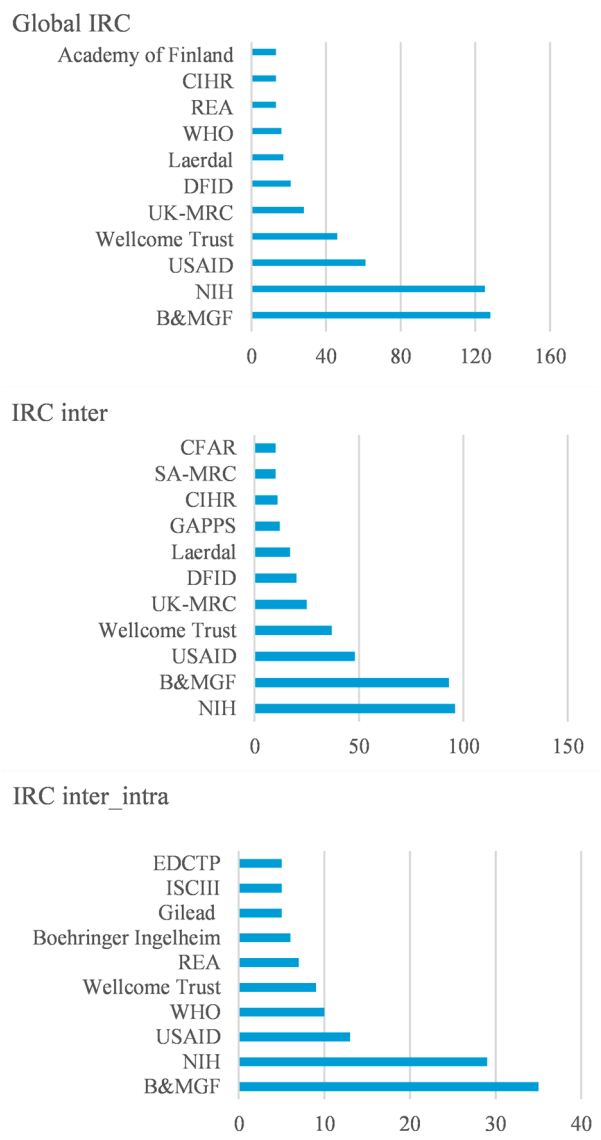

Figure 7. The top 10 institutions acknowledged in the articles according to the type of IRC (Global IRC, IRC inter for IRC involving one African country and one or more non-African countries, and IRC inter_intra for IRC involving more than one African country and one or more non-African countries).

In NC research with IRC, the institutions that appear the most as funders are from the USA (B&MGF, NIH, United States Agency for International Development (USAID)), the UK (Wellcome Trust, Medical Research Council (UK-MRC), and Department for International Development (DFID, replaced by the Foreign, Commonwealth & Development Office)), Norway (Laerdal), Belgium (REA), Canada (Canadian Institutes of Health Research (CIHR)), and Finland (Academy of Finland) (Figure 7, plot on IRC). These institutions are mentioned in 68% of the articles with IRC and information on funding.

As we look at the different types of IRC, for IRCinter (Figure 7), we see a great overlap of the institutions in the top 10; therefore, the findings are very similar to those of global IRC.

As for the collaboration between several African countries and one or more non-African countries (Figure 7, plot IRCintra_inter), the crucial role of B&MGF, NIH, and USAID as funders continues to emerge. However, other institutions of a different nature are unveiled, as pharmaceuticals Gilead Sciences, Inc (Gilead) and Boehringer Ingelheim, although with participation below that observed for B&MGF, NIH, and USAID. The Instituto de Salud Carlos III (ISCIII) and the European & Developing Countries Clinical

Trials Partnership (EDCTP) are also in the top 10. These institutions and partnerships are mentioned in 75% of the articles with IRCintra_inter and information on funding.

Finally, research conducted solely by African scientists (IRCintra) is funded by African and non-African institutions (SI, Table S9). Philanthropic and international institutions, universities, and pharmaceutical companies have funded these collaborations, but given the small number of articles, no pattern can be discerned.

While for the IRC and its types we found information on funding in 50% or more of the articles (SI, Table S11), for the DRC, only 19% of the articles (106 articles, SI, Table S11) acknowledge a funding source. If we consider these articles as a good representation of funding activities, we see that DRC is barely funded and that this research is dependent on African funding, as African institutions are acknowledged in 71% of the articles with DRC and funding information and non-African institutions in 31%. We can say that the funding structure is very fragile, as funding comes from institutions from 9 African countries (SI, Table S10) out of a total of 26 African countries with at least one article with DRC (SI, Table S12). These countries are among those with the highest DRC activity. It is also concentrated in two institutions: the SA-MRC and the NRF from South Africa (Figure 8) are mentioned in 33% of all articles with DRC and funding information. The institutions in the top nine are represented in 55% of the articles with DRC and funding information.

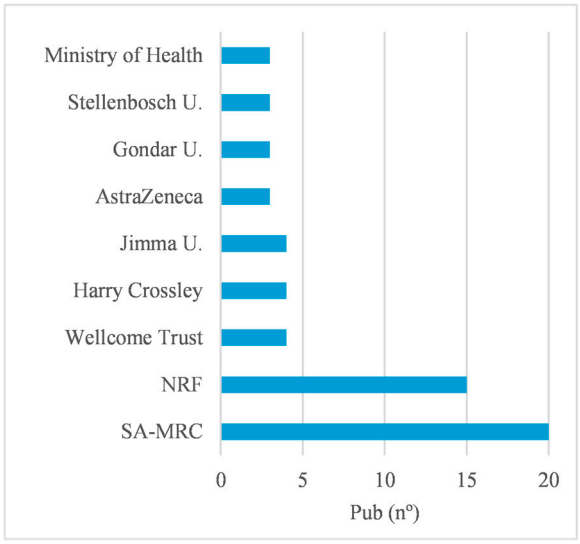

Figure 8. The top nine institutions that are acknowledged in articles with DRC.

4. Conclusions

The literature has shown that, in 2019, NCs were responsible for 39% of all DALYs in children younger than 5 years at the World level and that Africa contributed to 43% of these DALYs (WHO, 2020). Therefore, funding for NC research in Africa is critical to improve the ability to prevent, predict, detect, treat, and manage neonatal problems. In the absence of infrastructures that capture this information, bibliometrics can play an important role in providing an initial picture of funding activities.

We applied a bibliometric analysis of the funding information in the articles on NC research to analyze the funding activities. The analysis does not contemplate the amount of funding dedicated to the topic but rather the frequency of appearance of each funder in the articles. Despite the limitations, we believe this analysis provides an initial picture of funding activities related to NC research and highlights the usefulness of bibliometrics in this context.

The results are important for practice, policy, and future research.

NC research has attracted the attention of African and non-African funders, as the number of articles mentioning these funders has increased from 5 in 2000 to 105 in 2019 (out of a total of 611 articles with information on funding), as well as the number of African and non-African countries funding NC research. This shows scientists conducting or planning new research on NC that funders recognize the benefits of funding NC research and are open to new funding opportunities. The geographical distribution of funders has also increased, which might mean that there are more sources of funding.

In the NC research, 25% of all articles mention African funders, and 85% non-African funders. This shows those seeking funding that African funders have limitations in this regard and that the success rate could be low. From the perspective of policy makers, strategies to improve funding structures should contemplate reducing dependence on non-African funders. Reliance on non-African funders could leave many projects vulnerable when this funding runs out, posing a challenge to the long-term impact of NC research. Furthermore, heavy reliance on non-African funders may lead to vertical health programs prioritizing certain NCs and neglecting other important public health issues in African countries. Future research should explore whether this is the case.

Most African countries are not mentioned as funders of NC research: 21 countries were identified as funders, and 10 are mentioned in two or fewer articles. South Africa and Ethiopia stand out (56% of all articles mentioning African funders), as well as the SA-MRC and NRF from South Africa (27% of all articles mentioning African funders). The two countries and their institutions, particularly the SA-MRC and NRF, are paving the way in Africa regarding the funding of NC research from the perspective of African funders, even though Ethiopia's intervention is more recent than South Africa's (92% of articles published by Ethiopia on NCs appeared between 2015 and 2019, SI, Table S1). Scientists seeking funding should put South Africa and Ethiopia on their list of potential funders. Strategies are needed to increase funding activities in other African countries, and consideration can be given to including Ethiopia and South Africa as co-funders.

Co-funding activities between African and non-African funders are rare, as only 10% of all articles mention both funders and 75% mention only non-African funders. Strategies to improve the funding structure should consider the importance of co-funding activities. Co-funding activities help avoid duplication of effort that could arise if the foreign funder alone sets the research agenda.

The USA and the UK are the main funders; they are mentioned in 65% of all articles with funding information. Of the 479 funding organizations, the B&MGF and NIH are mentioned in 38% of all articles. Scientists seeking funding should consider these countries and institutions as important sources of funding. Strategies to strengthen the funding structure should focus on diversifying funding sources and maintaining the interest of these countries and institutions, but, as mentioned earlier, a balance must be found between funding from within and outside Africa.

As for articles with IRC and funding information, only 12% mention the participation of African funders. The pattern is reversed for articles with DRC, as African institutions are acknowledged in 71% of articles with DRC and funding information.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/publications13020026/s1, Table S1: Number of articles on NC research by African country; Table S2: Number of articles acknowledging funding from African countries; Table S3: Number of articles acknowledging funding from non-African countries; Table S4: Funding institutions and the number of articles they are mentioned in between 2000 and 2019; Table S5: The total number of institutions by country in the whole period; Table S6: Funding institutions recorded in the articles with IRC; Table S7: Funding institutions recorded in articles with IRCinter; Table S8: Funding institutions recorded in the articles with IRCinter_intra; Table S9:

Funding institutions recorded in the articles with IRCintra; Table S10: Funding institutions recorded in the articles involving DRC; Table S11: Number of articles according to the type of collaboration and the presence of funding information for the whole period; Table S12: Number of articles with DRC by African country; Table S13: The number of articles by non-African countries.

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