



## “Long walk to 2030”: A bibliometric and systematic review of research trends on the UN sustainable development goal 3



Saheed Adekunle Raji <sup>a,\*</sup>, Michael Olusegun Demehin <sup>b</sup>

<sup>a</sup> Department of Environmental Management and Toxicology, Federal University of Petroleum Resources Effurun, Nigeria

<sup>b</sup> Department of Health and Social Sciences, London School of Science and Technology, Aston Campus, Aston Cross Business Village, Birmingham, United Kingdom

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### ABSTRACT

**Background:** Since the initiation of the Sustainable Development Goals (SDGs) by the United Nations in 2015, researchers worldwide have investigated various aspects of it. One of the key areas of interest is the third SDG, which focuses on health, with its series of indicators.

**Objective:** This study aims to analyze the contributions of academia by using bibliographic mapping to examine scholarly publications on SDG health from 2015 to 2021.

**Methods:** We analyzed bibliographic data from The Lens database between 2015 and 2021 using Bibliometrix page and VOSviewer. Our analysis focused on scholarly productivity, bibliometric analysis, and geographic distribution of the outputs.

**Results:** We retrieved a total of 450 documents from The Lens database, with articles being the most dominant document typology at 99.8%. The mean age of the documents was 3.85 years, with a total of 18,440 citations. The mean citation per document was 40.98, and the mean citation per document per year was 5.85. The leading article, published in The Lancet journal, studied the effect of multiple adverse childhood experiences on health and received 1809 citations in five years. Keyword co-occurrence analysis generated three clusters, with the keyword ‘human’ appearing in 75.11% of all the publications. The University of London and World Health Organization were the leading institutions, while the United Kingdom, the United States, and Switzerland were the most productive countries.

**Conclusion:** This study provides policymakers working on SDG health with valuable insights into research gaps within the indicators and funding challenges facing developing countries.

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\* Corresponding author.

E-mail address: [raji.saheed@fupre.edu.ng](mailto:raji.saheed@fupre.edu.ng) (S.A. Raji).

## 1. Introduction

Since the adoption of the United Nations' Sustainable Development Goals (SDGs) in 2015 as a global socioeconomic development guide, governments around the world have taken a series of multidimensional steps towards achieving them. The 17 goals and 169 targets of the SDGs were designed not only to build on the successes of the Millennium Development Goals (MDGs) but also to advance progress towards a better world [1–3]. The transition from the MDGs to the SDGs reflects a shift in approach, moving from vertical to horizontal strategies to address global issues [1–2]. This change often requires a shift in procedures, especially where policymakers from different levels, sectors, and cultures are involved. At a glance, the SDGs aim to end poverty and hunger, reduce inequality, protect the earth, and ensure that people enjoy good health, justice, and prosperity. They also aim to build partnerships that will drive the envisioned development [4]. With a deadline of 2030, the SDGs are a call to action, often referred to as Agenda 2030 [2,4–5].

The third SDG, which focuses on “good health and well-being,” has been at the forefront of global discourse in recent times due to the series of health challenges that have enveloped the world [5–6]. These challenges, including the recent COVID-19 pandemic, have significantly disrupted existing structures designed to achieve the SDGs prior to the 2030 deadline [7]. Human health is closely linked to climate dynamics, and climate change caused by human activities has stimulated the emergence and spread of infectious diseases, such as malaria and water-borne diseases, among others [8–12]. Climate change has been identified as a proven driver of public health emergencies at a global scale [10–11]. Additionally, extreme weather events like floods, typhoons, and hurricanes have exacerbated health issues, including injuries, premature deaths, increased respiratory and cardiovascular diseases, and deteriorating mental health [10–12]. These emerging issues have added socioeconomic, political, and financial pressures to meet the targets and track the indicators of the third SDG, irrespective of a country's development status.

As the promotion and achievement of the SDGs require the efforts of all stakeholders, researchers across various institutions such as tertiary institutions, research agencies, and institutes have been actively involved. These researchers conduct studies, investigations, and analyses across different disciplines to track the progress of the SDGs [13–15]. They also provide consultancy and extra-academic services to communities regarding the progress and challenges associated with the SDGs. Additionally, researchers develop innovative solutions and inventions that are communicated through publications to various stakeholders, including policymakers at the governmental and non-governmental levels. These outputs are crucial for decision-making towards accelerating the achievement of the SDGs.

This study aims to analyze the contributions of academia to the third SDG through bibliographic mapping of scholarly publications between 2015 and 2021. The study has three objectives: (1) to assess the quantity and quality of research output during this period; (2) to analyze the evolution of hot topics by assessing keywords; and (3) to assess the geographic distribution of the leading global research institutions and countries on the third SDG. To achieve these objectives, open-source bibliometric databases and mapping and visualization software packages were utilized. The study's findings provide insight into research gaps related to the indicators of the third SDG and can aid policymakers in decision-making processes towards accelerating the achievement of the SDGs.

## 2. Methods

To ensure the accuracy and reliability of the results, the scope of the study was defined based on content sufficiency for bibliographic analysis. A large dataset that covers essential developments within the evolution of the subject matter was deemed necessary. As suggested by [16], a sufficient bibliographic data size for bibliometric analysis should exceed 200 papers. This standard was upheld in this study to ensure the sample size was adequate for bibliometric analysis of SDG health, thereby avoiding poor and erroneous outputs.

Bibliographic data was collected from The Lens database (<https://www.lens.org/>), which is an open-source repository of scholarly literature covering various fields of research. The database's recent partnership with PubMed, CrossRef, Microsoft Academic Graph, DOAJ, ORCID, and others has expanded its bibliographic database networks, providing more comprehensive coverage compared to subscription-based alternatives that do not support open science. The search string “SDG” AND “health” OR “SDG” AND “Goal 3” OR “SDG” AND “Goal 3: Good Health and Well-being” was used to query the database across the title and abstract for the period 2015 to 2021. The temporal range was based on the fact that 2015 was the transition period when the SDGs succeeded the MDGs. The year 2022 was excluded because the data acquisition was still in progress. The collected data was limited to peer-reviewed publications that included articles, conference proceedings, peer-reviewed book chapters, and papers in academic and professional organizations and associations to ensure interdisciplinary reviews and public interrogations beyond the immediate research network. The final dataset included 450 publications after inspection, filtering, and removal of duplicate entries for data analysis.

The analysis of the bibliographic data was performed using two open-source software packages: Bibliometrix and VOSviewer. Bibliometrix is a web-based software package developed using R that allows for the quantitative analysis of bibliometric and scientometric data across various analytical scopes. In this study, the Biblioshiny app interface developed by [17], was utilized to generate key scholarly information, author characterization, and citation analysis. VOSviewer, developed by [18], was used to visualize the connections between articles and identify clusters based on shared features such as keywords, co-authorship, and bibliometric coupling. By using these software packages, this study was able to provide a comprehensive analysis of the bibliographic data collected from the Lens database.

## 3. Results

### 3.1. Overview of the SDG health research output

The anthology of the data collected is presented in Table 1 showing the details of the documents, authors and their scholarly assessments. Out of the 450 documents, 99.8% are journal articles, and only 2 are book chapters, with an average age of 3.85 years. The entire collection of documents yielded a total of 18,440 citations, with a mean citation per document of 40.98 and a mean citation per year per document of 5.85, indicating that the focus on SDG health is gaining relevance and new research. The growth rate observed between the period 2015–2020 was 34.56%, affirming the

**Table 1**  
Synopsis of published articles on SDG health.

Description	Results
Timespan	2015:2021
Sources (Journals, Books, etc)	154
Documents	450
Annual growth rate of documents	– 30%
Document average age	3.85 years
Average citations per document	40.98
Average citations per year per document	5.85
Total citations (overall timespan)	18,440
References	19,139
Document Contents	
Keywords Plus (ID)	1234
Author's Keywords (DE)	1234
Authors Collaboration	
Authors	4101
Authors of single-authored docs	11
Authors of multi-authored documents	4090
Co-authors per documents	9.09
Collaboration index	12.24
Document Types	
Book chapter	2
Journal article	448

increase in research output. However, the cumulative annual growth rate of – 30% in 2021, with only 2 global publications compared to 75 in the previous year (2020), could be attributed to the impact of the COVID-19 pandemic, which caused a shift in research production. It is expected that the trend could turn positive as the mid-assessment of the SDGs draws near. In terms of research authorship, there were 11 single authors out of 4101, indicating that there were 4090 multi-authors. The overall collaboration index of 12.24, alongside 9.09 co-authors per document, signifies a high degree of diversified research interests in the SDG health.

### 3.2. Scholarly productivity on SDG health

The frequency of research publications and their associated citations are often considered a measure of their usefulness, influence, quality, and relevance to emerging issues. In this study, the frequency of publication outputs and their citations were considered fundamental to the growth and consideration of SDG health, especially within the context of sustainability science, as shown in Fig. 1. Notably, document production peaked in 2019 with 133, while citations peaked the previous year with 5897. A downturn was subsequently observed in 2020 and 2021, with the all-time-lowest of 2 citations recorded in 2021. This downturn can also be detected with the average citation per document, which showed that the year 2017 had the highest with 70.77, followed by 2018 with 57.25, while the least of 19.0 was recorded in 2021. Overall, the scholarly productivity showed that the global orientation towards SDG health is non-constant, and the downturn in monitoring the SDG health targets could be traced to the influence of COVID-19 concerns within the past two years [7,12].

An important aspect of evaluating scholarly productivity is the assessment of publications that have been trailblazers in their field. Such publications are typically identified based on their citation count and related metrics such as impact factor and h-index of the journal. Impact factor represents the average number of citations that articles published in a journal receive within a specified time frame, while h-index is a measure of the number of articles in a journal that have been cited a certain number (h) of times. Table 2 summarizes the top 10 articles based on these metrics, as determined from the bibliographic data collected. The study by [19], which examined the effects of multiple adverse childhood experiences on health, had the highest citation count with 1809 citations. This study provided a comprehensive meta-analysis of the various health and sociocultural dimensions of multiple adverse childhood experiences. The impact factor of 18.953 and h-index of 62 for the journal *The Lancet Public Health*, in which the study was published, indicates that it is a highly regarded journal for high-quality research in public health. The 10th most cited article by [20], published in *The Lancet* (impact factor 22.226 and h-index 807), had 222 citations within four years. This demonstrates that research related to SDG health is consistently linked to human survival.

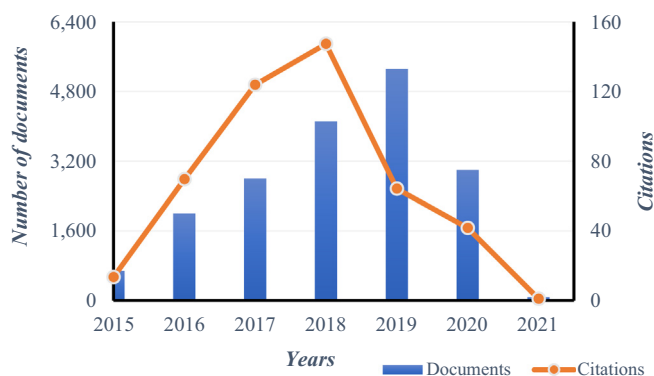


Fig. 1. The trend of research production (documents and citations) on SDG health from 2015 to 2021.

### 3.3. Bibliometric analysis

The analysis of the relationship between keywords was conducted through co-occurrence mapping, which illustrates the connections between specific terminologies used in a published article. Co-occurrence mapping is essentially a semantic network. Typically, an article should have at least five keywords that are associated with the research topic. In this study, all 2456 keywords were considered, and only 174 keywords that occurred at least 5 times in the entire 450 articles were selected. The resulting network graph is presented in Fig. 2, which displays the connections between keywords and three clusters indicated in red, green, and blue. The size and boldness of each circle and text in the clusters represent the strength of their co-occurrence with other keywords, while the distance between items and lines indicate the affinity and connections of the keywords, respectively. The three clusters each convey a thematic distinction, headed by the main keyword.

The first cluster (cluster 1) in red is headed by the keyword “human” with the highest number of co-occurrences (338), links (173), and link strength (2372) (as shown in Table 3). The co-occurrence value indicates that the keyword “human” appeared in 338 articles, which accounts for 75.11% of all publications analyzed. Other associated keywords in this cluster include “middle aged,” “health policy,” “global health,” and “child health,” suggesting that this cluster could be referred to as “human health services and policy.” In total, the cluster comprises 77 keywords, and some of these keywords are shared with the adjoining clusters.

Cluster 2, denoted in green, is centered on health issues related to males and growing age. The main keywords in this cluster are male (105 co-occurrences), young adult (65 co-occurrences), adolescent (63 co-occurrences), child (50 co-occurrences), and cross-sectional studies (46 co-occurrences), which explain the theme of the cluster. In total, the cluster has 34 constituent keywords that relate to health issues in the developing world. Therefore, keywords such as ‘child development,’ ‘child mortality/trends,’ ‘infants,’ and ‘infant mortality’ are also featured. Countries such as ‘Bangladesh,’ ‘Burkina Faso,’ and ‘Nepal’ are identified as members of this cluster. This suggests that studies that belong to this cluster are also location-specific, with a focus on the male and growing age population.

The third cluster (cluster 3), symbolized in blue, focuses on maternal health systems and services. It is headed by the keywords “female,” “adult,” and “pregnancy,” with co-occurrence weights of 189, 100, and 79, respectively. Other associated keywords include “antenatal care,” “mothers,” “midwifery,” “quality of care,” “reproductive health,” and “obstetric delivery,” which are part of the 63 keywords in this cluster. This cluster also has location-specific research as keywords such as “Africa,” “Africa south of the Sahara,” “Cambodia,” “Ethiopia,” “Ghana,” “Kenya,” “Malawi,” “Nigeria,” “Tanzania,” and “Uganda” are featured within the keyword space.

### 3.4. Geographical distribution of SDG health research

The retrieved 450 articles on SDG health were obtained from over 60 countries with various affiliated institutions. Table 4 presents the top 20 most productive institutions, their countries, citations, and average authors per institution. Collectively, these institutions contributed to roughly 87.8% of the total publications.

As of 2021, the University of London was the leading institution in SDG health-related research globally, followed by the World Health Organization, Liverpool School of Tropical Medicine, University College London, and Harvard University within the top 7 (Table 4). These institutions have citations exceeding 1000, with an average number of authors ranging from 7.9 to 42.8. The average number of authors is a measure of research collaboration, which is a pointer to ontological diversity into the published articles. Institutes from the Western world dominate the ranks due to their huge research funding capacity, which stimulates knowledge production. Often, these institutes possess modern technologies, tools, equipment, facilities, structures, and systems that stimulate both funding and research into several areas of health concerns [21]. The high-income countries on the list



**Table 3**  
Highly occurring keywords.

Keywords	Cluster number	Links	Total link strength	Occurrences
Humans	1	173	2372	338
Female	3	166	1724	189
Male	2	151	988	105
Adult	3	147	1047	100
Pregnancy	3	136	775	79
Young adult	2	133	761	65
Adolescent	2	131	694	63
Middle aged	1	123	631	58
Child	2	106	435	50
Cross-sectional studies	2	109	454	46

include the United Kingdom, United States, Switzerland, and Sweden. Notably, the only Africa-based institute on the list is the University of Cape Town, rated 15th with 17 articles and 652 citations, contributed by an average of 53.7 authors.

The countries' aggregate knowledge production regarding SDG health is visually presented in Fig. 3, which highlights the dominance of wealthy countries in producing scholarly research. This also explains why these countries ranked among the top 10 most innovative countries globally, according to the Global Innovation Index of 2022 [22]. Furthermore, these countries were the leading ones in the World Index of Healthcare Innovation by the Foundation of Research on Equal Opportunity (FREOPP) in 2021 [23].

**Table 4**  
Most productive institutions.

N	Institution Name	Country	Number of documents	Citations	Average number of authors
1	University of London	United Kingdom	98	3412	14.9
2	World Health Organization	Switzerland	37	1475	26.6
3	Liverpool School of Tropical Medicine	United Kingdom	30	1100	9.7
4	University College London	United Kingdom	22	1067	34.3
5	Harvard University	United States	21	1553	42.8
6	University of Leeds	United Kingdom	17	729	7.9
7	Johns Hopkins University	United States	15	834	27.9
8	Karolinska Institutet	Sweden	14	426	51.5
9	Swiss Tropical and Public Health Institute	Switzerland	14	455	9.1
10	University of Oxford	United Kingdom	14	714	50.1
11	University of Basel	Switzerland	14	687	45.6
12	University of Edinburgh	United Kingdom	13	777	49.8
13	King's College London	United Kingdom	12	621	53.7
14	International Institute for Applied Systems Analysis	Austria	11	687	13.4
15	University of Cape Town	South Africa	11	354	53.7

#### 4. Discussion

The present study demonstrates that while research on SDG health is increasing, the observed negative growth rate is not surprising for a developing field. This finding aligns with previous studies [21,24], which suggest that fluctuations in research output in a particular field do not necessarily imply a lack of innovation but may be due to unforeseeable events, such as the COVID-19 pandemic. Despite this, the aggregate number of citations, which exceeded 18,000, and the high collaboration index indicate a growing interest in SDG health worldwide.

The leading scholarly publication on SDG health, [19], with 1809 citations within 5 years, emphasized three critical factors that drive increasing citations within a short time: relevance to global development, publication channel (journal), and collaboration. The article was authored by 8 researchers from the UK, Denmark, Switzerland, and Australia. Therefore, diverse authorship with a globally relevant topic often attracts divergent research interest. The leading publication channels associated with the leading research on SDG health are top-rated Q1 journals based in the developed world. This shows that most of the developing world, particularly sub-Saharan Africa (SSA), which has been reported to face gross health issues, particularly tropical diseases such as malaria, yellow fever, cholera, and tuberculosis, has lowly ranked research institutes and research publishing complexes. The low level of funding for tertiary research is at the heart of this issue. It has been reported that low funding will hinder the attainment of the SDGs [13]. In fact, [25] affirmed that 19% of the gross domestic



**Fig. 3.** Geographic distribution of the top 10 countries with research output on SDG health.

product in 2030 is significant to accelerate projected progress. [26] advocated for funding gaps and institutional reforms that will gear up development at the local institution levels. Additional measures should include building partnerships with stakeholders to increase funding sources and for capacity building through global collaborations.

The keywords network provides a snapshot of the various sub-topics that researchers have investigated in the context of SDG health, which has attracted increasing interest. However, there are still some indicators that require greater attention to ensure a healthy planet. Research on exposure to different types of pollution and contamination, as well as healthcare financing in the developing world, remains limited, as highlighted by the COVID-19 pandemic, which has disrupted existing healthcare systems and structures [25]. This has further revealed the global health risks that arise from local to global levels.

It is important to acknowledge the limitations of this study. Research from developing countries in Asia, Latin America, and Africa is often not included in commercial databases such as Scopus and Web of Science. Furthermore, some research may not be recognized by The Lens database but could be published in LILACS and SCIELO, which have a limited global research footprint owing to their focus on Latin America, the Caribbean, and other regions, particularly in the fields of health sciences and social sciences. Therefore, future research should include these sources to gain a more comprehensive understanding. Additionally, it is necessary to expand the design architecture of The Lens to allow for more in-depth analysis, such as citation tracking, field of study evolution, and output refinement. Output refinement should be improved to prevent infiltrations from articles that were not included in the search.

## 5. Conclusion

Using bibliographic analysis of articles published from 2015 to 2021, this study evaluated studies on SDG health to reveal their development, present hotspots, and gain deeper knowledge of key issues. By evaluating the intellectual domain and identifying research keywords that express the hotspots, pertinent research documents, institutional influences, and collaboration networks associated with SDG health globally, the methods used in this study help to advance our understanding of the evolutionary trends of studies. One fundamental takeaway from this study is the need to integrate the influence of possible global disruptions to the existing developmental agenda, as shown in the case of COVID-19. The expected shift towards resolving the pandemic scourge left multidimensional holes in the previous attempts to ensure that the targets towards SDGs are met. It is essential to integrate such unexpected pandemics into the global development agenda. The issue of global health financing and research funding within sub-Saharan Africa (SSA) is also inevitable if the intended good health and well-being are to be met before the termination period.

## 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.

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