

Malnutrition Research Output: A Bibliometric Analysis for articles Index in Web of Science between 1900 and 2020

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ABSTRACT

Introduction: Malnutrition is a significant cause of child morbidity and mortality, and it remains a global health issue with high prevalence. Here, we carried out a bibliometric survey to provide global scientific research output on malnutrition and identify the research gaps and future research direction from published papers searched in Web of Science (WoS).

Methods: A comprehensive analysis was generated by searching the WoS database. Medical Subject Headings (MeSH), was used to search terms “Malnutrition” or “Malnourishment” or “Nutritional Deficiency” or ‘Undernutrition’ or ‘Nutrition Disorders.’ Was used to retrieve article published in between 1900 and 2020. Only original research and review papers published in English were included in the analysis. SPSS, HistCite, Bibliometrix app.” (Using R), and VOSviewer ver 1.6.6 were used for analysis.

Results: Research output peak from 1972 to 2007 with 100(0.99%) articles, in 2008 to 2012 with more than 200 (1.98%) articles, while the year 2019 and 2020 had the least more than 500 (4.95%) articles per year. The United States ranked first in terms of the number of articles 1947(19.28%), followed by United Kingdom 604 (5.98%), and Brazil 412 (4.08%). In addition, our analyses revealed a significant correlation between the total number of citations Year science publications($r=0.9216$, $p<0.0001$), and between number of countries ($r=0.9219$, $p<0.0001$), and number of Number of authors ($r=0.4149$, $p<0.0001$), and Institution ($r=0.5534$, $p<0.0001$), Journal h_index ($r=0.6927$, $p<0.0001$), and Journal impact factors ($r=0.6364$, $p<0.0544$).

Conclusion: This bibliometric analysis provides insights into the global overview on the annual trend of the global malnutrition research output, institution, journal, authors, and countries.

Keywords: malnutrition, global research, Web of Science, bibliometric analysis, VOSviewer, HistCite

INTRODUCTION

Malnutrition over the last century has been a worrisome morbidity condition that remains a disease burden globally [1] and subsequently drained global economic resources [2]. However, there has been concerted effort to ensure that people of all ages are less vulnerable to the intricacy of malnutrition [3] through researches and investment programs from governments, NGOs, and private entities. With these efforts, the developed countries have witnessed massive progress in combating malnutrition that was equally diffused into the developing countries. This progress is measured in terms of reduced child mortality attributed to low malnutrition prevalence, longer life expectancy for the aging population,

and improved maternal health services. The persisting malnutrition situation in developing countries negates these achievements as malnutrition is a global problem that requires international policies and research [4].

In recent years, maternal and child malnutrition attention has shifted to the population in developing countries. Some of the focal points for research are evidenced in the problem of overweight and obesity. The incidence of maternal overweight and obesity has steadily increased since early 1980 and exceeds underweight in all world regions [5]. It has since been reported that lower birth weight and undernutrition were risk factors for high glucose concentrations and increased blood pressure rate [6].

Similarly, malnutrition which includes undernutrition (wasting, stunting, underweight), inadequate vitamins or

minerals, overweight, obesity, and resulting in diet-related non-communicable diseases, is a complex problem that affects people in every country. Approximately 52 million of the children under-fives are suffering from wasting, 462 million are underweight, and 1.9 billion adults worldwide are overweight or obese. And it continues to affect the lives of millions of children and women worldwide [7-12] which is associated with many socioeconomic factors [13]. Therefore, the effort to solve malnutrition spurred rapid progress with several recent advances and research productivity to combat high mortality and disease burden [14,15].

Furthermore, malnutrition feast on the population with underlying health conditions and subsequently distorts medical treatments' progress. In specific, people with renal conditions [16-18], geriatric population [19,20], hospital patients [21], and cancer patients [22] are some of the most susceptible in the global community. While this means research on methods and approaches to combating malnutrition must continue, it is crucial to adjudicate trends and progress of research on malnutrition globally.

Like in review articles [23-25], the utilization of Bibliometrics Analysis, a tool and technique widely used by many researchers worldwide [26,27], presents a cumulative understanding of malnutrition eradication effort. The analytical approach of annual trends of publication, institutions, journals, authors, country and international collaboration networks, citations, keywords occurrence, and contributed funding agency can help researchers and decision-makers gain insight into the research productivity to understand scientific research progress in malnutrition-related publications better.

Therefore, the study aimed to assess the global research output focusing on malnutrition research and identify the most influential factors associated with the citations and further identify the research gaps and future study direction.

MATERIAL AND METHODS

Data Sources

Published peer-reviewed articles on malnutrition were retrieved from the Web of Science (WoS) database (<https://apps.webofknowledge.com/>) through a comprehensive online search of documents published between the years 1900-2020.

Search Strategy

All the malnutrition-related publications from WoS were collected on a single day (on 20 February 2021) by two researchers (THM & HHM) to avoid the WoS database update. A comprehensive search was conducted by using Medical Subject Headings (MeSH), which is available on (<https://meshb.nlm.nih.gov/search>). The following terms searched as follows: Title: Malnutrition*" OR "undernutrition" OR "Nutrition Deficiency" OR "Nutrition disorders" OR "malnourishment" Timespan: All years (1900-2020), and documents Indexes: Science Citation Index Expanded (SCI-EXPANDED) and Social Sciences Citation Index (SSCI). The search was restricted to only "article" and "review, and for documents only written in English regarding document types. Finally, the resulting bib.txt data was downloaded from WoS, and as a result, 10100 documents related to malnutrition were

Table 1. Main Information about data on malnutrition

Description	Results
Timespan	1905:2020
Sources (Journals, Books, etc)	2033
Documents	10100
Total citations of the documents	263742
Average years from publication	23.3
Average citations per documents	26.11
Average citations per year per doc	1.7
References	203413
Document types	
Article	9307 (92.15%)
Review	793 (7.85%)
Document contents	
Keywords Plus	10028
Author's Keywords	9447
Authors	
Authors	31003
Author Appearances	46501
Authors of single-authored documents	1045
Authors of multi-authored documents	29958
Authors collaboration	
Single-authored documents	1459
Documents per Author	0.326
Authors per Document	3.07
Co-Authors per Documents	4.6
Collaboration Index	3.47

the subject of further analysis. To account for variations in the publications, the Growth Demand Production (GDP) for each country were retrieved from the website <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD>.

Ethical consideration

There is no formally constituted research ethics required for this study since all data were open sources and do not involve human or animal subjects.

Bibliometric Indicators and Mapping Visualizations

The following data were extracted from the retrieved publications: title, year of publication, author details, country, institution, journal, and citation number. This method was used to evaluate citation density (i.e., an average of the number of citations received per year and per article), the annual trend of publications, most productive authors, institutions and journals, and country contributions. The study's quality of publications was assessed using the Hirsh-index (h-index) [28]. The impact factor (IF) for the year 2019 was presented for the top 10 journals reported.

Data Analysis

Network analysis of co-authorship was also analyzed and visualized using VOSviewer software [29]. Bibliometrics (an R package) [30], GraphPad Prism 5 [31] were used for frequency analysis and data visualization. Correlation Coefficient between the variable were conducted to assess the relationship between variables. A P-value less than 0.05 was considered statistically significant.

General Characteristics of study

Table 1 shows the various types of retrieved documents information. A total of 2033 journals, 31003 Authors, and with Collaboration Index 3.48 were contributed to produce 10100 studies on Malnutrition-related publications. Among the total

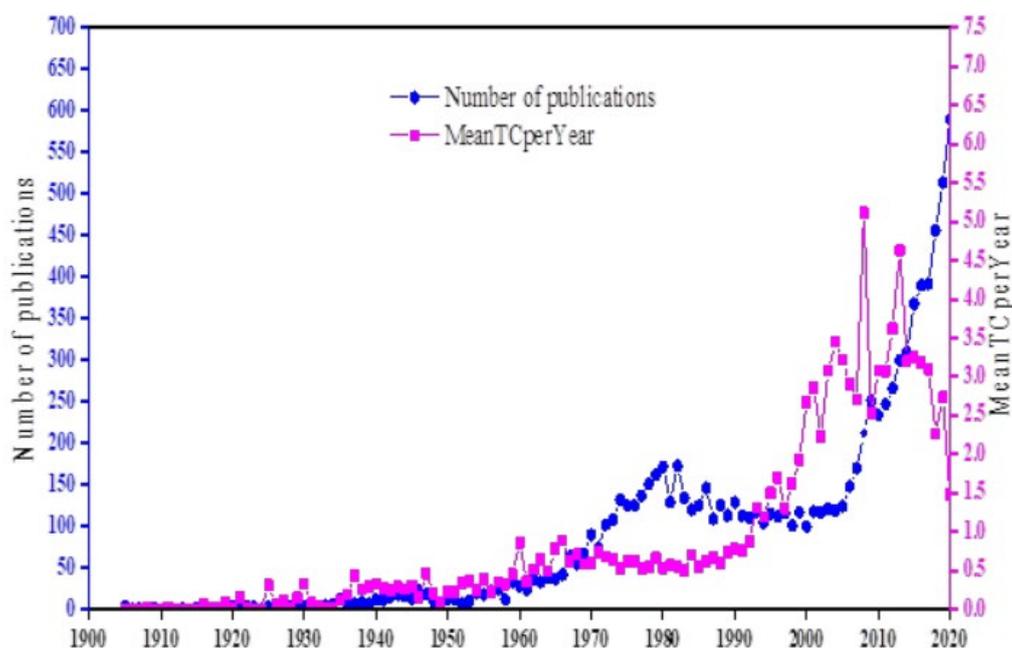


Figure 1. Global publication and citation trend in Malnutrition-related publications

Table 2. Top 10 highly cited articles in malnutrition

SCR	Date Author / Journal	TC	TC/t	TD
1	Black RE, et al. Maternal and child undernutrition 1-Maternal and child undernutrition: global and regional exposures and health consequences. <i>Lancet</i> . 2008 JAN 19; 371(9608):243-260	2890	206.43	Review
2	Black RE, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. <i>Lancet</i> . 2013 Aug 3; 382 (9890):427-451	2851	316.78	Review
3	Victora CG, et al. Maternal and child undernutrition 2-Maternal and child undernutrition: consequences for adult health and human capital. <i>Lancet</i> . 2008 Jan-Feb; 371(9609): 340-357	1706	121.86	Review
4	Stenvinkel P, et al. Strong association between malnutrition, inflammation, and atherosclerosis in chronic renal failure. <i>Kidney International</i> . 1999 May; 55 (5): 1899-1911	1274	55.39	Comparative Study
5	Bhutta ZA, et al. Maternal and Child Undernutrition 3 - What works? Interventions for maternal and child undernutrition and survival. <i>Lancet</i> . 2008 Feb 2; 371 (9610): 417-440	1181	84.36	Review
6	Winick M, Noble A. Cellular response in rats during malnutrition at various ages. <i>Journal of Nutrition</i> . 1966; 89 3: 300-&	966	17.25	Review
7	Correia MITD, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. <i>Clinical Nutrition</i> . 2003 Jun; 22 (3): 235-239	937	49.32	Article
8	Rubenstein LZ, et al. Screening for undernutrition in geriatric practice: Developing the Short-Form Mini-Nutritional Assessment (MNA-SF). <i>Journals of gerontology series A-biological Sciences and Medical Sciences</i> . 2001 Jun; 56 (6): M366-M372	888	42.29	Article
9	Mcwhirter JP, Pennington CR. Incidence and Recognition of malnutrition IN-Hospital. <i>British Medical Journal</i> . 1994 Apr 9; 308 (6934): 945-948	872	31.14	Articles
10	Bistrian BR, et al. prevalence of malnutrition in general medical patients. <i>JAMA-Journal of the American Medical Association</i> . 1976; 235 (15): 1567-1570	746	16.22	Article

SCR: Standard competition ranking, TC: Total number of citations, TC/t: Average of Total citations per year, TD: type of documents

number, 9307 (92.15%) were research articles, and 793 (7.85%) are review papers.

Annual Trend of the Publications

Figure 1 shows the number of retrieved articles in Malnutrition-related publications per year along with their average mean of score. The number of articles increased by 100 between 1972 to 2007 and more than 200 articles in 2008 to 2012, while those published in the year 2019 and 2020 had more than 500 articles per year.

Top 10 Highly Cited Articles in Malnutrition

The top 10 highly cited articles on in malnutrition-related publications were presented in **Table 2** [5,6,14,16,19,32-36]. Of the top 10 list, 5 were review articles, 4 research articles, and a comparative study. The article which received the highest

number of citations was “Maternal and child undernutrition 1-Maternal and child undernutrition: global and regional exposures and health consequences” published by Black RE et al. (2008) with obtained 2890 citations [14], followed by “Maternal and child undernutrition and overweight in low-income and middle-income countries” published by Black RE et al. (2013) with obtained 2851 [5].

Authors Productivity

The top 10 active authors also showed that four authors were from the USA, and only one author from Kenya, one from Bangladesh, two from England, and two from Copenhagen, Denmark. Similarly, Galler JR from Harvard Medical School, Dept Psychiat, Boston, USA was the most influential authors with produced 86 articles, with h_index 29 and total citations score 3122 times, followed by Briend A from University of

Table 3. Top 10 productive authors in malnutrition

Author	University	h_index	g_index	TC	NP	PY_start
Galler, J.R.	Harvard Medical School, Department of Psychiat, Boston, USA	29	53	3122	86	1977~2020
Briend, A.	University of Copenhagen, Fac Sci, Frederiksberg, Denmark	15	31	991	47	1979~2020
Ahmed, T.	International Centre for Diarrhoeal Disease Research (ICDDR), Nutr & Clin Serv Div Dhaka, Bangladesh	16	44	2097	44	2007~2020
Kerac, M.	University of London, London Sch Hyg & Trop Med, London, England	15	25	697	40	2008~2020
Berkley, J.A.	KEMRI Wellcome Trust Research Programme, Kenya	16	29	887	38	2006~2020
Friis, H.	University of Copenhagen, Departments of nutritional Exercise & Sports Copenhagen, Denmark	11	20	455	37	2002~2020
Tonkiss, J.	Boston University, Boston, USA	22	37	1664	37	1983~2011
Morgane, P.J.	University of New England -Maine, Dept Biomed Sci, Biddeford, USA	22	36	2074	36	1974~2019
Manary, M.J.	Washington University, Dept Pediat, USA	17	31	964	34	1997~2020
Mccance R.A.	King's College Hospital NHS Foundation Trust, London, England	21	34	1422	34	1953~1969

TC: Total number of citations, NP: Number of articles

Table 4. Top 10 productive and influential countries in malnutrition

Country (N=119)	NP	(%)	GDP (US\$)	NP per GDP	TC	SCP	(%)	MCP	(%)
USA	1947	19.28	97.799	101	71519	1500	14.85	447	4.43
United Kingdom	604	5.98	2.829	214	20715	424	4.20	180	1.78
Brazil	437	4.33	1.84	238	10152	379	3.75	58	0.57
India	412	4.08	2.869	144	4530	373	3.69	39	0.39
Australia	283	2.80	1.397	203	8158	203	2.01	80	0.79
France	273	2.70	2.716	101	8484	186	1.84	87	0.86
China	255	2.52	14.343	18	2877	200	1.98	55	0.54
Canada	239	2.37	1.736	138	5994	162	1.60	77	0.76
Japan	237	2.35	5.082	47	3503	208	2.06	29	0.29
Spain	196	1.94	1.393	141	3850	155	1.53	41	0.41

NP: Number of articles, GDP: Gross Domestic Product, TC: Total citations, SCP: Single country Publications, MCP: Multiple country publications

Table 5. Top 10 journal contributes in malnutrition

Source	h_index	TC	NP	IF (2019)	5 year rank	Journal rank
American Journal of Clinical Nutrition	63	14458	341	6.77	7.831	Q1
British Journal of Nutrition	45	6550	214	3.334	4.284	Q1
Journal of Nutrition	48	7866	190	4.281	5.075	Q1
Clinical Nutrition	52	10193	187	6.36	6.28	Q1
Plos One	28	2590	176	2.74	3.227	Q2
Nutrition	39	5805	166	3.639	4.118	Q2
European Journal of Clinical Nutrition	29	2666	113	3.291	3.447	Q2
Nutrition Reviews	21	1641	113	6.50	7.617	Q1
Journal of Tropical Pediatrics	18	1140	109	0.94	1.239	Q4
Journal of Parenteral and Enteral Nutrition	30	3917	104	2.853	3.881	Q3

TC: Total citations, NP: Number of articles

Copenhagen, Fac Sci, Frederiksberg, Denmark with published 47 articles and received h-index 15 and total citations 991 times (**Table 3**).

Top 10 Productive Countries

A total of 119 countries contributed to publishing articles on malnutrition. **Table 4** shows the top 10 active and influential countries in publishing malnutrition-related documents. The top 10 active countries participated in publishing a total of 4883 (48.35%). The United States of America (USA) (1947; 19.28%) had the most outstanding share of publications in malnutrition, followed by the United Kingdom (UK) (604; 5.98%), Brazil (437; 4.33%), and India (412, 4.33%). Other countries such as Australia, France, China, Canada, Japan, and Spain were leading countries for research during the study period and were also listed within the top 10 productive and active countries. There is a significant correlation between the number of articles and total citation score ($r=0.990$, $P<0.0001$), followed by the number of articles and MCP ($r=0.997$, $P<0.0001$), and SCP ($r=0.874$, $P<0.0001$).

The top 10 journal contributes in Malnutrition-related publications are presented in **Table 5**. American Journal of Clinical Nutrition with h_index (63) is the top active journal, followed by the British Journal of Nutrition h_index (54), Clinical Nutrition with h_index (52), and Journal of Nutrition with h_index (48).

The most frequency of Keywords Plus. The top 25 indexed Mesh Keyword Plus are “nutritional-status” (905), followed by “mortality” (761), “nutrition” (644), “prevalence” (587), and “Children” (576), “impact” (340), “disease” (314), “risk-factor” (237), “care” (235), “management” (223), “Body mass index” (218), “subjective global assessment” (182), “weight-loss” (180), “malnourished children” (172), “outcomes” (172), “association” (171), “metabolism” (165), and “expression” (164).

Figure 3 shows the common conceptual frameworks in retrieved articles on malnutrition-related publications determined by using the Factorial Analysis and Corresponding Analysis method, with five clusters of 1,7,6,7, and 79 elements showed research responses focused on “gene-expression”,

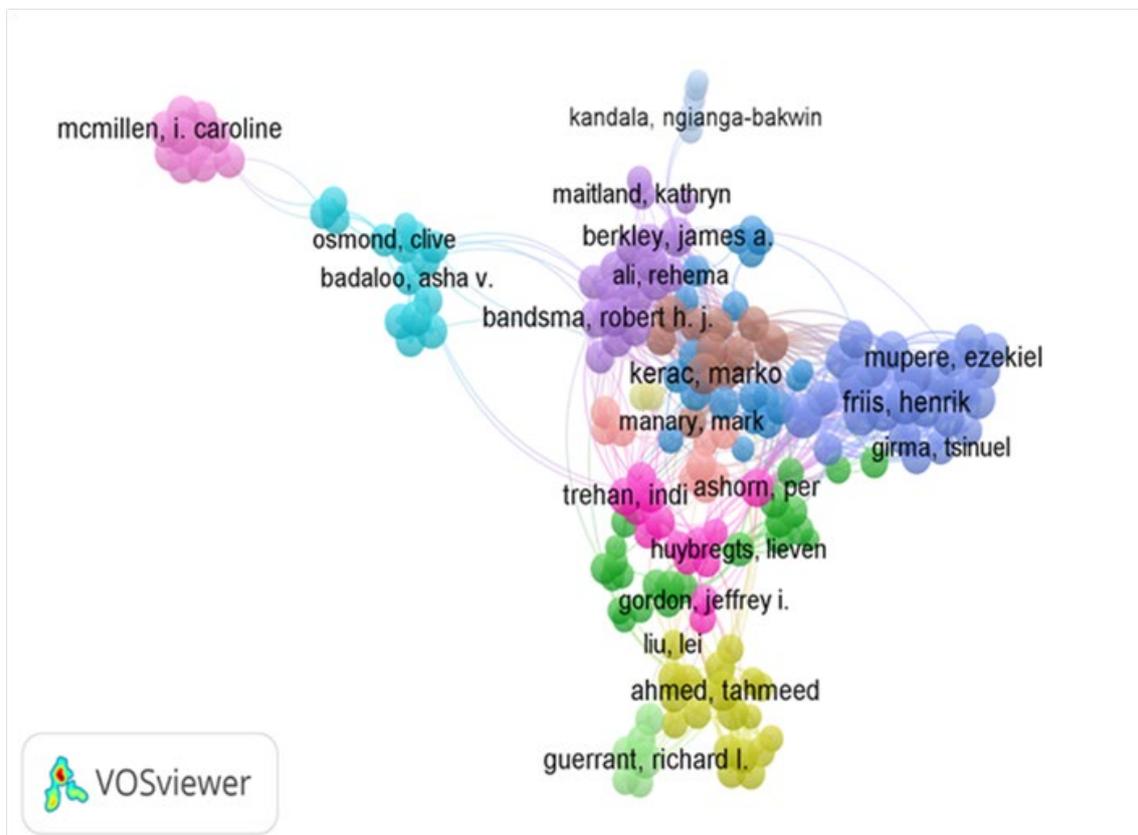


Figure 4. Co-authorship network among productive Authors

Table 6. Top 10 active institution and research area in malnutrition

Organizations Enhanced research			Research Areas		
Organizations	NP	(%)	Research area	NP	(%)
University of London	404	4.000	Nutrition dietetics	2,966	29.366
Harvard university	239	2.366	Pediatrics	1,083	10.723
University of California System	203	2.010	general internal medicine	912	9.030
University College London	175	1.733	Public Environmental Occupational Health	868	8.594
London school of Hygiene tropical medicine	168	1.663	Neurosciences Neurology	573	5.673
Universidade de sao paulo	149	1.475	Endocrinology Metabolism	432	4.277
Institute national de la sante et de la recherche Medicale inserm	139	1.376	Research Experimental Medicine	342	3.386
Johns Hopkins university	139	1.376	Tropical Medicine	337	3.337
University of Toronto	114	1.129	Science Technology other topics	313	3.099
Cornell university	107	1.059	Geriatrics Gerontology	309	3.059

NP: Number of articles

together in thirteen distinct groups (TLS =2857). Also, our results revealed that Friis, Henrik (TLS=217), Kerac, Marko (TLS=130), Berkley, Marko (130), Trehan, Indi (TLS=65), Guerrant, Richard I. (TLS=48).

Organizations and Research Area in Malnutrition

The table revealed the top 10 organizations and research areas that enhanced research on malnutrition. The most productive Organizations were the University of London (404, 4.00%), followed by Harvard University (239, 2.366%), the University of California System (203, 2.010%) of Malnutrition articles, and the University College London (175; 1.733%) of Malnutrition articles. The top research area on Malnutrition is Nutrition dietetics (2,966, 29.366%), followed by Pediatrics (1,083, 10.723%), and General Internal Medicine (912, 9.03%), and Public Environmental Occupational Health (868, 8.594%), were most of the top research area (Table 6).

Table 7 shows that the most funding is come from the United States Department of Health Human Services 678(6.71%), followed by National Institutes of Health (NIH) USA 669(6.62%), and NIH Eunice Kennedy Shriver National Institute of Child Health Human Development 207 (2.05%), respectively.

Factors Affecting the Number of Citations

The comprehensive investigation of possible factors influencing citations in malnutrition research articles was presented in Table 8. The significant correlations were found between the number of citations and Year science publications ($r=0.9216$, $P<0.0001$), number of countries ($r=0.9219$, $P<0.0001$), and number of Number of authors ($r=0.4149$, $P<0.0001$), and Institution ($r=0.5534$, $P<0.0001$), Journal h_index ($r=0.6927$, $P<0.0001$), and Journal impact factors ($r=0.6364$, $P<0.0544$).

Table 7. Top 10 funding Agencies on Malnutrition-related publications

Record Count	NP	(%)
United States Department of Health Human Services	678	6.71
National Institutes of Health NIH USA	669	6.62
NIH Eunice Kennedy Shriver National Institute of Child Health Human Development	207	2.05
NIH National Institute of Diabetes Digestive Kidney Diseases Niddk	151	1.49
Wellcome trust	113	1.11
National Council for Scientific and Technological Development	111	1.09
Nih National Institute of Allergy Infectious Diseases	104	1.03
UK Research Innovation UKRI	102	1.01
Medical Research Council UK MRC	80	0.79
Bill Melinda Gates Foundation	76	0.75

Table 8. Factors affecting the number of citations in malnutrition articles

Factor	Spearman's r	P value
Year science publications	0.9216	<0.0001
Number of authors	0.4149	<0.0001
Journal h_index	0.6927	<0.0001
Journal impact factors (2019)	0.6364	0.0544
Number of countries	0.9219	<0.0001
Institution	0.5534	<0.0001

DISCUSSION

This study is the first to examine the bibliometric analysis of global research on malnutrition to the authors' knowledge. The current research findings elucidate the extent to which researchers have made efforts to curb malnutrition globally. The bibliometric analysis output offers a robust insight into publications and empirical evidence of global malnutrition-related problems in the WoS. Based on the research finding, over 116 years, there have been 10,100 studies on malnutrition with an estimation of 92% original research articles and 8% review articles. There was a notable rise in research on malnutrition-related topics five years after the year 2000. This sharp rise may be attributed to the global policy framework baseline date on the Millennium Development Goals (MDGs) [37]. The MDGs ushered in strong interest from researchers to explore result-centered investigations and risk factors for malnutrition, including the most vulnerable groups. Subsequently, there was corroborative evidence on reduced malnutrition on a global scale [38-40]. Similarly, the introduction of the sustainable development goals (SDGs) [41] ensured continued effort to maintain MDGs achievement. Subsequently, research output in the WoS stays on the upward swing.

The retrospective observation of citation for top scientific evidence on malnutrition shows the three most cited articles were on maternal and child malnutrition deficiencies. Other top citations were from research on prominent vulnerable groups: those with kidney ailments, the aging population, and general medical patients. The first three were review article that presents an aggregation of research evidence on maternal and child undernutrition while focusing on the global and regional exposure, overweight in low and middle-income countries and the health consequences. Although these results show that more attention has been placed on maternal and child malnutrition-related issues, it also suggests that these groups are the most susceptible to malnutrition globally. This assertion is consistent with the micro bibliometric study of health and medical research in Nepal [42] that found child and maternal malnutrition as leading health research and

bibliometric evidence comparing malnutrition research in academia against social media [43].

Other prominently cited articles bordering on renal issues, aging groups, and hospital patients create a paradigm for addressing the population vulnerable to malnutrition. Over the years, the aging population and their vulnerability to malnutrition have gained extensive attention, and there has been increased number of research in Saudi Arabia [44]. Similarly, renal citations have equally gained research prominence [45].

Beyond the most cited research publications, some of the most prominent authorship and institution were from the United States, England, and Denmark. While recent evidence has identified that most recent global malnutrition cases are prevalent in developing countries [46,47], only Kenya and Bangladesh were among the top authors globally. This exposition suggests a significant dearth of authorship coming from the developing countries represented in the web of science databases. If there were authorship, they lack global exposure that could facilitate immediate, worldwide distribution and accessible empirical evidence on malnutrition-related problems. However, the leading authorship position coming from the United States and Europe should be acknowledged, as they remain instrumental in facilitating the eradication of the global problem of malnutrition.

Our keyword analysis also demonstrated that the most common keywords included were nutritional statuses, mortality, nutrition prevalence, and children, among others. The keyword "children" stand out the most, like the one identified as an entity from all the terminologies. This discovery enshrines the global vulnerability of children to malnourishment, prevalence, and the associated risk factors. Malnutrition in children, therefore, proves to be a nagging global problem that requires continuous intervention. Additionally, the term "Mortality" consolidated the consequence of malnutrition. Especially in developing countries, mortality attributed to malnutrition remains problematic [3,48]. There is sufficient interconnectedness of the keywords that are significant to the experience of children's malnutrition-related issues. From this evidence, "diarrhea"

and “birthweight” are some of the “risk factors” of malnutrition that may result in child “morbidity” and “mortality” incidences. Evidence has shown that diarrhea [49], and birth weight [48], are aggravators for child morbidity and mortality. Equally important is the occurrence of “body-mass index” and “body composition” as some of the measures of identifying the presence of malnutrition in patients.

Although children were prominent in the keyword analysis, maternal malnutrition equally appeared but less frequent. There are shreds of evidence of maternal undernutrition as impactful on newborns [50]. The analytical output of keywords suggests that nursing mothers or pregnant women are equally vulnerable to malnutrition and directly influence a child’s health outcome. Thus, the nexus between maternal and child issues requires more studies to fast-track efforts to reduce morbidity risks [51].

Other significant keywords identified in the analysis offer insightful findings on some of the dynamics and associated risks of malnutrition. One of the occurrences and evidence of malnutrition is a severe shortage of “protein” and other energy “supplementation.” This evidence supports the progress made in clinical studies exploring the potential effect of protein shortage on the human body [52]. The investigation of protein “deficiency” as a causative factor of malnutrition over the years, as evidenced in the keyword analysis, supports progress being made in research outputs. Thus, intervention for malnutrition patients should entail how supplements can be accessible, increase higher metabolism, and reduce malnutrition risk, especially in regions with the highest prevalence of malnutrition among vulnerable groups. The word “metabolism” appeared consistently in the keyword analysis. The repeated occurrence of metabolism may be closely associated with “protein” as a consistent keyword in literature, and the inability of the body to metabolize nutrients may cause excessive “weight-loss.” This assertion may be a result of underlying diseases in the body that may affect protein metabolism. The clinical studies exploring malnutrition may also account for “rats” in the keyword analysis and “gene-expression” [53]. The cumulation of these keywords shows the extensive studies that have been conducted among “communities” and “developing countries” in an effort towards “subjective global assessment” of the “prevalence,” to examine the “quality-of-life,” and “health,” “outcome” of malnutrition.

As initially indicated, the bulk of the top research on malnutrition is from the developed countries’ contribution, asides in India and China who have both the characteristics of developed and developing countries. Sub-Saharan Africa did not make the top ten contributing authorship in malnutrition publications based on the WoS database search. In line with this recurring evidence, Sub-Saharan Africa and other developing nations across Asia, South America, and the Pacific are behind in global contributors in malnutrition research in the Web of Science. Concurrently, the lack of research, data, and contribution may hamper sustainable development goals, especially in sub-Saharan Africa [54]. Based on the assessment of the most influential publishing journals on malnutrition, the American and European journals remain top of the hierarchy. The first two are the American Journal of Clinical Nutrition and the British Journal of Nutrition.

In the combination of productive authors and the institution of affiliation, the network analysis revealed that Fris Henrik, Kerac Marko, Berkley Marko, Trehan Indi, and Guerrant

Richard has a minimum of 5 publication on malnutrition. Simultaneously, the University of London and Nutrition dietetics is the most prominent organization in research and focus. Represented in this cohort of the distinct organization are three organizations; Universidade De Sao Paulo (Brazil) and institute national de la Sante et de la recherche Medicale Inserm (France) and Cornell University (Canada) that are non-American and Britain Institutions. Reverting to the initial evidence that the bulk of the current global malnutrition is prevalent in developing countries, it is safe to assume a shortage of developing country’s organizational representation supporting publications addressing malnutrition in the Web of Science. A closer look at the research focus on malnutrition in the top contributing organization suggests that malnutrition’s social determinant may have been overlooked as most research focus on pediatric, tropical, and clinical medicine.

The most prominent funders of malnutrition-related publications are nested in the United States, United Kingdom, and Brazil. Although Bill and Melinda Gates foundations are private donors, the NGO location is in the United States. Not to overstretch this, non-representation of developing countries in funding and over dependency may slow the global progress on lessening malnutrition.

Lastly, the rationale for citations of malnutrition publication is evidenced in the year of publication. Early studies created a template and made a direction for recent researches. Similarly, the number of authors was significantly correlated with the number of citations garnered by a malnutrition article. The journal h_index appears to be a significant determinant of if an author is going to cite an article. The h_index and a journal impact factor represent a vital indication of journal quality, and subsequently, authors tend to cite from such empirical evidence. Like the impact factor, the number of countries contributing and institutions directly correlated with malnutrition publication citations.

The implication of this research evidence accentuates the need to re-strategize and refocus some of the identified research patterns that have gained prominence over the last century in the WoS. At this junction, it is pertinent to eliminate various forms of the political debacle that may cloud intervention and policy framework to eliminate global malnutrition and use the same global political harmony to reduce the global prevalence of malnutrition [55]. In particular, the developing countries are in dire shortage of authorship, organization, publishing journals, and country representation on the web of science. Thus, a concerted effort should be made to create an enabling environment for authors, institutions, and journals from developing countries to thrive. If this method is adopted, the result is to accelerate the reduction of malnutrition in developing countries.

Similarly, as children are the most illustrious term in most of the WoS publications, it is essential to acknowledge that they are endangered and vulnerable groups. Therefore, an all-inclusive global action must be intensified to eradicate malnutrition among them. The same goes for the population suffering from underlying ailments, the aging population, and hospital patients caught in the web of malnutrition. Lastly, it is also pertinent for developing countries to generate funds for malnutrition research to increase and encourage researchers in the regions.

This current research’s novelty is the first bibliometric analysis on malnutrition as a wholesome topic (original article

and review papers). However, the limitations must be considered when adopting the study research findings. We only used the WoS database to obtain released publications spanning over a century. Equally important, we excluded other types of documents such as book chapters, editorial materials, research notes, proceeding papers, book reviews, corrections, and conferences from the analysis. We did not include other databases for comparisons such as Scopus, PubMed, Google Scholar, and other non-English databases published. This procedure might affect the credibility of our results. Therefore, future research could consider using other databases and fill the research gaps.

In summary, there is a remarkable global effort towards solving the problem of malnutrition. The study shows the general increasing trend of research in malnutrition. There are substantiated evidence and progress on research centering on “care” and “support,” “management,” and “guidelines” to help people with malnutrition-related issues in the keyword analysis. These show that concerted global effort is in progress to manage malnutrition problems as a transition is made towards a malnutrition-free global environment. Also, the United States and Britain remain pivotal in bringing malnutrition prevalence to a halt, as identified in the current study. Overall, the developed countries have contributed a fair share of the authorship, organization, publishing journals in the Web of Science which acclimatized their effort in solving malnutrition-related problems. And lastly, the developing countries should be inculcated into the progress in malnutrition research. Therefore, funding should be made available in the region, especially sub-Saharan Africa, to facilitate more representation in the WoS.

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