


REVIEW

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Knowledge mapping and visualization of current sarcopenia and cancer research: a bibliometric analysis

Marwa Mohammed^{1,2,3*}  and Jianan Li^{3*}

Abstract

Background Cancer survivors face broad challenges in weight loss due to multiple factors. Sarcopenia prevalence among cancer survivors has a wide range and is associated with worse outcomes. Sarcopenia and cancer attract global attention. The use of bibliometrics analysis in this area of interest still needs to be identified. This study was performed to assess the global trends and patterns of sarcopenia and cancer-related scientific publications.

Methods Web of Science (WOS) and articles indexed in Science Citation Index Expanded. VOS viewer (Leiden University, Leiden, Netherlands) and R-studio using bibliometrics and R package were used for quantitative analysis of the dataset (year of publications, number of publications, institutes, journals, total citations, H-index status, authors, hotspots of institutes, Keywords, research area, and funding sponsor.

Results Our analysis extracted 384 publications from 172 journals written by 2525 authors from the Institute for Web of Science Core Collection database. Overall, 384 articles from the WOS database met the inclusion criteria. The number of published papers has risen since 2014. The results showed that Japan, China and the USA contributed the most to this field. Moreover, our results recognized future research trends and the current condition of sarcopenia and cancer research based on the top 10 most cited articles and the keyword analysis. Finally, the leading author's analysis demonstrated that Shen Xian from Wenzhou Medical University, China, Baracos and Vickie E from the University of Alberta, Switzerland, were the most productive, active, and influential authors.

Conclusion Our study demonstrates a comprehensive and objective overview of the up-to-date status of sarcopenia and cancer research. These data would benefit scholars who need information on sarcopenia and cancer research. It would be a reference guide for researchers wanting to conduct additional studies related to the topic.

Keywords Sarcopenia, Cancer, Web of science, A bibliometric, Science citation index expanded

1 Background

Cancer is the second principal cause of death globally [1]. However, cancer treatments have improved significantly, leading to an expanded life span post-diagnosis and an increasing number of advanced cancer survivors [2]. That may be due to the advances in early detection methods and treatment and the ageing and growth of the population using advanced applications [3, 4].

During cancer treatment, the patient often faces broad challenges in weight loss caused by protein-calorie malnutrition (PCM) [5]. Sarcopenia within cancer patients

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could be referred to as α -motoneuron loss, increased interleukin-6 secretion (IL-6), and inhibition of growth hormone secretion, in addition to treatment-related factors such as inactivity and malnutrition [7–9]. These accumulated factors could result in substantial muscle wasting by suppressing appetite and activating the ubiquitin–proteasome and Nuclear factor- κ B (NF- κ B) pathway [6], increasing challenges to prevent and treat sarcopenia. Sarcopenia is commonly associated with worse outcomes, including progressive frailty, falls, fractures, physical limitation and death [10]. An earlier study found sarcopenia prevalence among cancer survivors ranged from 14 to 79% [3]. Scholars found sarcopenia is more prevalent in cancer patients and related to adverse surgical results. They were additionally associated with elevated incidence of chemotherapy-induced cytotoxicity and worse prognosis.

Although no medical intervention has been explored or identified to treat this disease, malnutrition extensively affects outcomes in cancer patients. Earlier studies confirmed that malnutrition was common in cancer patients, e.g. gastric, pancreatic, lung, prostate, and colon cancer, with incidences varying from 30 to 85% [9]. Complications in cancer patients are hard to maintain unless they have a sufficient dosage of vitamins and minerals [12, 13]. Those survivors require dietary supplements that contain anti-inflammatory, anticancer, antioxidant, and immunomodulatory properties [11]. Furthermore, exercise and physical activity are crucial for cancer survivors during their journey of treatment and post-therapy [14]. Exercise prevents muscle breakdown by restoring redox homeostasis by increasing the production of antioxidants and anti-inflammatory rather than pro-oxidants as exercise training increases IL-6, IL-10 and IL-1ra while reducing tumour necrosis factor alpha (TNF-alpha) [15].

The area of sarcopenia and cancer has recently become a research point of interest. Many scholars paid much more attention and effort to the fields by covering broad topics [16], predicting postoperative infections and inpatient rehabilitation [17], monitoring sarcopenia status in overweight or obese patients with late-stage of pancreas cancer [18] and cancer-associated malnutrition in the elderly [19]. The use of bibliometrics is a particular sort of quantitative and qualitative analysis used by many scholars. It comprehensively analyses the research trends, research productivity and authorship achievement of current status. So the techniques have played a significant role in the past years among scholars [4, 20–32], with an enormous explosion of scientific publications and research over the past few decades due to the rapid growth in electronic databases, bibliometrics has become an essential instrument for tracking trends in scientific research [33, 34]. The bibliometric study helps to cover

the majority of scientific results and supports the policy-making and better understanding of scientific fields [23, 25, 27, 28, 35–39].

This study aimed to intuitively show the global research trends in research on knowledge structure based on sarcopenia and cancer-related publications indexed in the Web of Science database by using a bibliometric analysis as a newly developed visualization tool. These investigations will help scientific researchers understand the research status and frontier trends better. Furthermore, the results could present helpful knowledge and quantitative insights to future researchers to understand the surge in research output associated with sarcopenia and cancer-related publications for further investigation and publication.

2 Main text

2.1 Materials and methods

2.1.1 Study design

Bibliometric investigation methods based on Knowledge mapping were developed as an essential part of mining tools to evaluate the global trends of sarcopenia's influence and innovation patterns in cancer patients-related scientific publications.

2.1.2 Data sources

Metadata of the sarcopenia in cancer patients-related publication were collected from the Web of Science (WOS) Core Collection, editions Science Citation Index Expanded (SCI-Expanded) was used for the study (<https://www.webofscience.com/>) as is used as an information retrieval platform, and the Journal Citation Reports (<https://jcr.clarivate.com/jcr/home>) were both accessed on October 1, 2022. WOS is the most acknowledged and appropriate database for subsequent bibliometric analysis over the past years that enables users to search current and retrospective multidisciplinary information from over 12,000 research journals globally; besides it provides scholars with the most influential and credible information, it is delivered to assess the trends and citation graphically, search across all authors and author affiliations, identify trends and publication patterns through used quantitative analysis techniques [20, 21, 28, 38, 40–42].

2.1.3 Search strategy

The search was developed using mesh terms for Cancer and Sarcopenia as follows: “Cancer” (Title) or “Benign neoplasms” (Title) or “malignancy” (Title) or “malignant neoplasms” (Title) or “neoplasia neoplasm” (Title) or “neoplasms” (Title) or “benign” (Title) or “tumours” (Title) AND “sarcopenia” (Title).

Two independent researchers reviewed and evaluated the cited articles. Original and reviewed articles were included in the study, while our finalized data set excluded meeting abstracts, letters, editorial materials, and corrections. In addition, the language of publications is limited to English, while other publications published in French, German, and Spanish were excluded. Finally, a total of 384 valid publications on sarcopenia in cancer patients from the retrieval results are kept and saved. These publications include the bibliographical information such as (year of publications, citation of the publications, authors, journal, institution, countries or region, research area, funding organizations, references, and keywords) which were identified and exported as Bib TeX or CSV file or plain text or tab-delimited file format for further analysis (Fig. 1).

2.1.4 Data analysis

Quantitative analysis was conducted using R-Studio, a free and open-source development environment of R run on the windows operating system. The Bibliometrics package was used for data analysis and interpretation [43]. And the VOS viewer (version 1.6.6) package

(Leiden University, Leiden, The Netherlands) was used for mapping and visualization of the co-authorship and co-citation networks [44]. All statistical analysis was performed using SPSS version 19.0 for windows. The p -value < 0.05 was considered statistically significant.

2.2 Results

2.2.1 Evolution and current status of scientific research

Overall, 384 documents were published till December 2021. Overall, 324 articles accounting for 84.37%, and 60 review papers accounting for 15.62% of selected publications, were included in the final analysis. The first article on sarcopenia and cancer-related publications were published in 2005, and very little enhancement was found in the following ten years. There was a small peak in the number of studies in 2015 ($n=12$). Then, scholars' attention to sarcopenia, and cancer research gradually increased sarcopenia and cancer subjects, which led to a jump in publications number in 2019 to ($n=59$) articles, followed by 2020 to ($n=71$) articles, and in 2021 to ($n=104$) articles (Fig. 2).

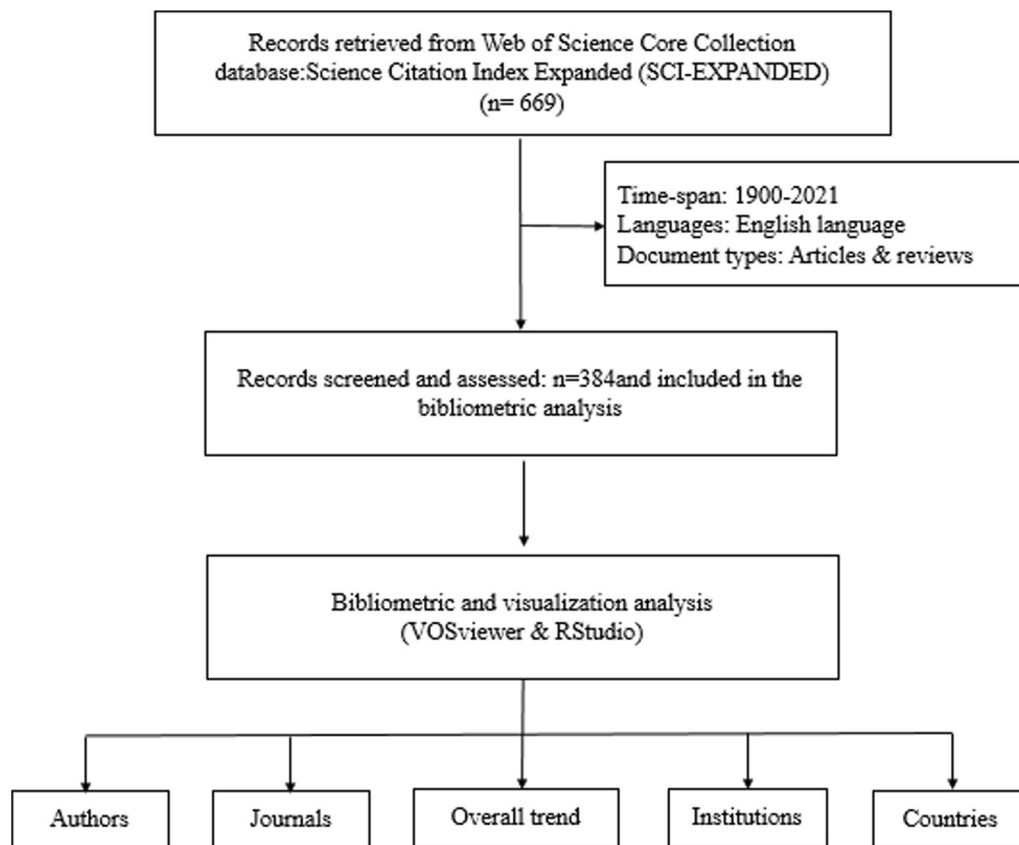


Fig. 1 The process of literature search and flow diagram

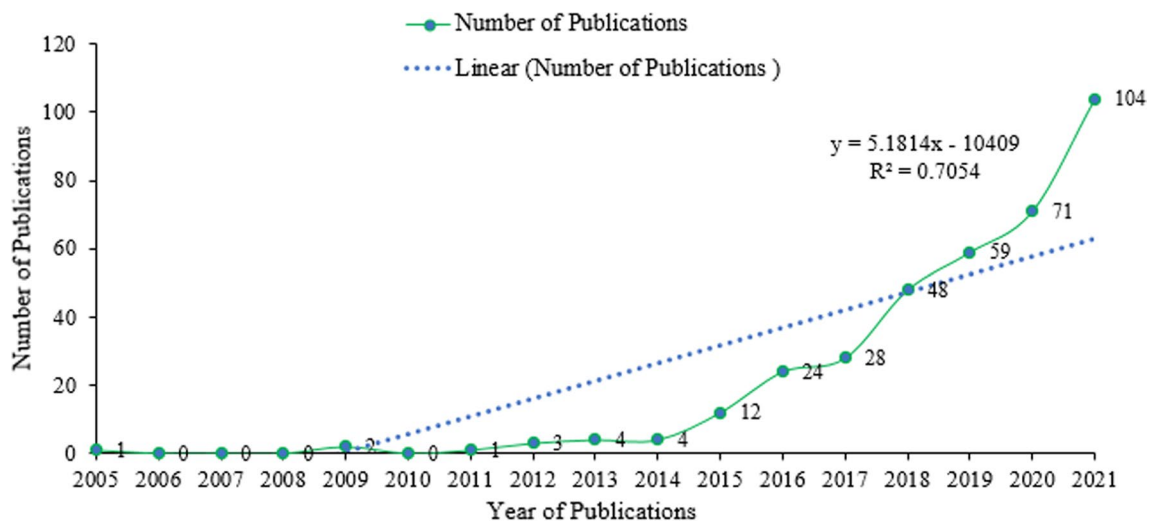


Fig. 2 The annual trends of sarcopenia in cancer patients-related publications

2.2.2 Characteristics and H-index analysis of articles

According to the data analysis selected from WOS, all sarcopenia and cancer-related publications were cited 12,970 times in total, 4997 times cited without self-citations, and h-index 57. Of 172 sources, 635 Affiliations, 33 webs of science categories, 261 funding agencies were contributed by 2525 authors with 8.41 Co-Authors per article and 15.36 International co-authorships (Table 1).

2.2.3 Top cited articles

Analysis of the top 10 most cited articles in sarcopenia in cancer patients-related publications based on the number of received citations is depicted in Table 2. The top

10 articles range from 164 to 691 times. The top cited articles were published in 2009 entitled “Sarcopenia as a determinant of chemotherapy toxicity and time to tumour progression in metastatic breast cancer patients receiving capecitabine treatment”.

2.2.4 Author’s analysis

The top 10 most productive authors on sarcopenia and cancer-related publications are shown in Table 3. Shen Xian from Wenzhou Medical University, China, published the most significant number of articles (11, 2.86%), followed by Zhuang, Cheng-Le from Tongji University, China, with published (10, 2.58%), and Baracos, Vickie E

Table 1 Basic characteristics of metadata on sarcopenia in cancer patients-related publications, 2005–2021

Description	Results	Description	Results
Sources (Journals, Books, etc.)	172	Authors Collaboration	
Documents	384	Single-authored docs	1
Time cited	12,970	Co-Authors per Doc	8.41
Time cited without self-citations	4997	International co-authorships %	15.36
Average citations per doc	33.78	Document types	
Annual growth rate %	19.94	Article	324
Document average age	2.96	Review	60
References	7916	h_index	57
Document contents		Others information’s	
Keywords plus (ID) ^a	693	Affiliations	635
Author’s keywords (DE) ^b	564	Web of science categories	33
Authors		Funding Agencies	261
Authors	2525	Corresponding Authors country	32
Authors of single-authored docs	1		

^a Frequency distribution of keywords associated with the document by WOS. ^bFrequency distribution of the authors’ keywords

Table 2 Top 10 cited articles on sarcopenia and cancer-related publications, 2005–2021

References	Articles	TNC	TC per year
Prado [16], Clin Cancer RES	Sarcopenia as a Determinant of Chemotherapy Toxicity and Time to Tumor Progression in Metastatic Breast Cancer Patients Receiving Capecitabine Treatment	691	49.36
Lieffers [17], Brit J Cancer	Sarcopenia is associated with postoperative infection and delayed recovery from colorectal cancer resection surgery	504	45.82
Tan [18], Clin Cancer Res	Sarcopenia in an Overweight or Obese Patient Is an Adverse Prognostic Factor in Pancreatic Cancer	467	33.36
Reisinger [47], Ann Surg	Functional Compromise Reflected by Sarcopenia, Frailty, and Nutritional Depletion Predicts Adverse Postoperative Outcome After Colorectal Cancer Surgery	312	39.00
Ryan [19], P Nutr Soc	Cancer-associated malnutrition, cachexia and sarcopenia: the skeleton in the hospital closet 40 years later	241	34.43
Zhuang [48], Medicine	Sarcopenia is an Independent Predictor of Severe Postoperative Complications and Long-Term Survival After Radical Gastrectomy for Gastric Cancer Analysis from a Large-Scale Cohort	233	33.29
Miyamoto [49], Ann Surg Oncol	Sarcopenia is a Negative Prognostic Factor After Curative Resection of Colorectal Cancer	225	28.13
Feliciano [50], JAMA Oncol	Association of Systemic Inflammation and Sarcopenia with Survival in Nonmetastatic Colorectal Cancer Results from the C SCANS Study	206	34.33
Psutka [51], Cancer-Am Cancer Soc	Sarcopenia in Patients with Bladder Cancer Undergoing Radical Cystectomy Impact on Cancer-Specific and All-Cause Mortality	196	21.78
Huillard [46], Brit J Cancer	Sarcopenia and body mass index predict sunitinib-induced early dose-limiting toxicities in renal cancer patients	164	16.40

Table 3 Top 10 most influential authors on sarcopenia and cancer-related publications, 2005–2021

Authors' names (n = 2525)	Institutions (Country)	h_index	TC	NP	PY_start
Shen Xian	Wenzhou Medical University, China	9	734	11	2015
Zhuang, Cheng-Le	Tongji University, China	9	765	10	2015
Baracos, Vickie E	University of Alberta, Switzerland	8	1853	9	2009
Williams, Grant R	The University of Alabama Birmingham, UK	8	323	8	2015
Yu Zhen	Tongji University, China	8	710	9	2015
Kim, Young Saing	Gachon University, South Korea	7	161	8	2016
Maehara, Yoshihiko	Kyushu Cent Hosp, Japan	7	381	7	2016
Wang, Su-Lin	Wenzhou Medical University, China	7	681	8	2015
Huang, Dongdong	Southeast University, China	6	611	7	2015
Kim, Eun Young	Chungnam National University, South Korea	6	318	7	2015

from the University of Alberta, Switzerland (9, 2.34%). Of the top 10 authors, five were from China; two were from South Korea (Table 3).

2.2.5 Annual publication and country collaboration analysis

Eligible publications were published in 32 corresponding authors' countries. The details of the single-country publication (SCP) collaboration and multiple-country publications (MCP) are reported in (Table 4). Japan is the leading corresponding author's Country for research in sarcopenia and cancer-related publications, with 74 articles, followed by China with 70 articles. Details on the annual trends of the number of articles per country that vary over the years are presented in Fig. 3A, and

inter-state relations between the countries that contributed to sarcopenia and cancer patients-related publications at the level of international collaboration are shown in Fig. 3B.

2.2.6 Distribution of published journals

A total of 384 articles were published in 172 journals. The ten most popular journals in sarcopenia and cancer-related research are presented in Table 5. The number of publications from the top 10 journals accounts for 102 (26.56%) articles. The journal with the most significant publications was *Annals of Surgical Oncology*, with 15 articles, followed by *Clinical Nutrition*, with 15 articles making the most positive contributions to the field. The

Table 4 Top 10 corresponding author’s country contributed to sarcopenia and cancer-related publications, 2005–2021

Country (n=32)	Articles	SCP	MCP	Freq	MCP_Ratio
Japan	74	72	2	0.193	0.027 ^a
China	70	66	4	0.182	0.057 ^a
USA	51	38	13	0.133	0.255 ^a
Korea	37	35	2	0.096	0.054 ^a
France	16	12	4	0.042	0.250 ^a
Italy	16	13	3	0.042	0.188 ^a
UK	14	12	2	0.036	0.143 ^a
Netherlands	13	10	3	0.034	0.231 ^a
Turkey	13	13	0	0.034	0.000 ^a
Brazil	12	7	5	0.031	0.417 ^a

SCP, Single-country publication (intra-country collaboration); MCP, Multiple-country publications (inter-country collaboration)

^a Lower International Collaboration (Value: Less 0,50). ^bHigh International Collaboration (Value: More than 0.50)

top 10 Journals focus on oncology, nutrition & dietetics, Geriatrics & Gerontology, and Health Care Sciences & Oncology, reflecting the close links between sub-topics of sarcopenia and cancer-related publications.

2.2.7 Top institutes, web of science categories, and funding sponsors

The top 10 most creative institutions, web of science categories, and funding sponsors contributed to sarcopenia and cancer, summarized in Table 6. Wenzhou Medical University published the highest article

number (20, 5.20%); then, the University of Alberta (13, 3.38%) and Tongji University (12, 3.12%) of 33 subject areas reported during the study period. Most of the sarcopenia and cancer-related publications were indexed in the area of Oncology (176, 45.83%), followed by Nutrition Dietetics (55, 14.32%), and Gastroenterology Hepatology (30, 7.813%). Of 261 organizations that supported and enhanced publication productivity (The National Institutes of Health NIH USA) is among the leading organizations contributing to (25, 6.51%) articles.

2.2.8 Keywords analysis and research hotspots

Keywords reflect an article’s core content and ideas, and the frequency of the co-occurrence could reveal the research hotspots for sarcopenia and cancer-related publication to support the research effectively—Fig. 4A shows the annual trends of the author’s Keywords, which deeply provide a reference for follow-up research on sarcopenia and cancer-related publications. Moreover, in Word cloud of the most frequently top 100 Keywords Plus analysed using biblioshiny, we derived the top 10 keywords Plus (in order of highest frequency). Only the top 10 were listed as “body composition” (122), followed by “survival” (97), “skeletal-muscle” (95), “Obesity” (84), “cachexia” (78), “impact” (73), “resection” (70), “outcome” (68), “prevalence” (65), and “chemotherapy” (56), among others (Fig. 4B).

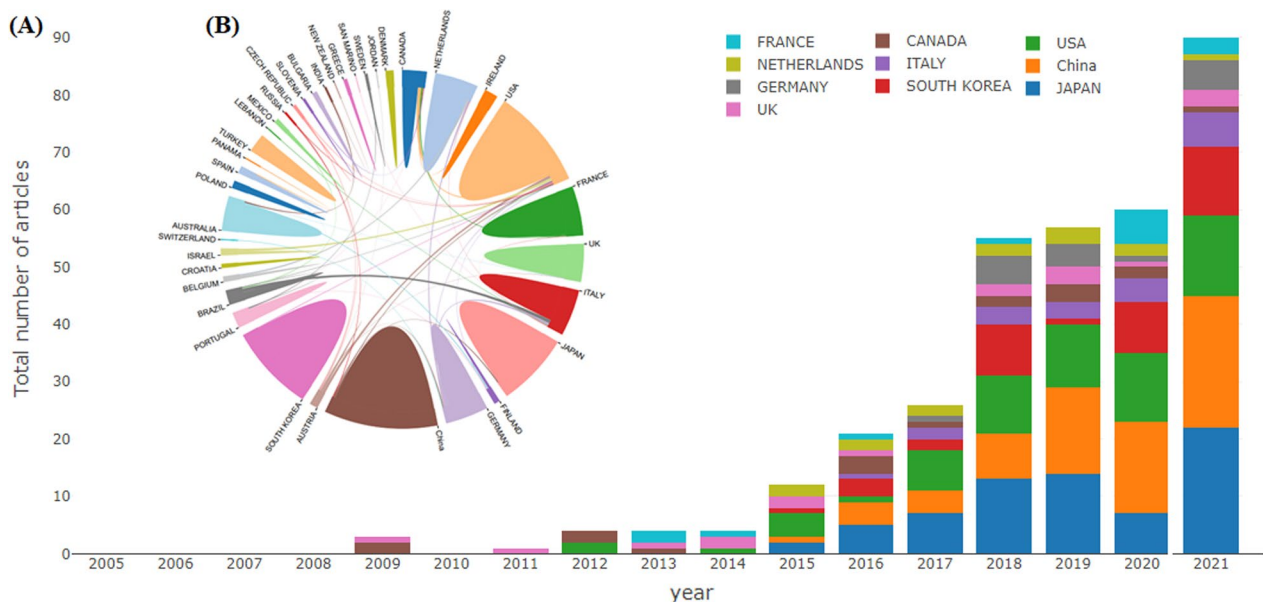


Fig. 3 Annual trends of the number of articles in the top 10 countries vary over the years (A), and inter-state relations between the countries (B) contributed to sarcopenia and cancer-related publication

Table 5 Top 10 published Journals

Journal names (n = 172)	h_index	TNC	TNP	JIF (2021)	Region	JCR Category
Annals of Surgical Oncology	13	909	15	4.339	USA	Oncology
Clinical Nutrition	12	553	15	7.643	Scotland	Nutrition and Dietetics
Anticancer Research	9	232	10	2.435	Greece	Oncology
Supportive Care in Cancer	9	304	14	3.359	USA	Health Care Sciences and Oncology
EJSO	7	435	8	4.037	England	Oncology
Journal of Cachexia Sarcopenia and Muscle	7	460	10	12.063	Germany	Geriatrics and Gerontology
Frontiers in Oncology	6	126	8	5.738	Switzerland	Oncology
Journal of Geriatric Oncology	6	162	6	3.929	Netherlands	Geriatrics and Gerontology
Nutrition And Cancer-an International Journal	6	238	7	2.816	USA	Nutrition and Dietetics
Cancers	5	161	9	6.575	Switzerland	Oncology

Table 6 Top 10 authors' institutions, web of science categories, funding sponsors

Institutions (n = 635)	% of 384	(%)
Wenzhou Medical University, China	20	5.20
University of Alberta, Canada	13	3.38
Tongji University, China	12	3.12
Sungkyunkwan University SKKU, Hungarian	10	2.60
Samsung Medical Center, South Korea	9	2.34
Harvard University, USA	8	2.08
Maastricht University, Netherlands	8	2.08
Udice French Research Universities, France	8	2.08
Uni cancer, France	8	2.08
University of Alabama Birmingham, UK	8	2.08
Web of science categories (n = 33)		
Oncology	176	45.83
Surgery	79	20.57
Nutrition Dietetics	55	14.32
Gastroenterology Hepatology	30	7.813
Medicine General Internal	30	7.813
Geriatrics Gerontology	24	6.250
Health Care Sciences Services	24	6.250
Rehabilitation	16	4.167
Medicine Research Experimental	15	3.906
Radiology Nuclear Medicine Medical Imaging	13	3.385
Funding Agencies (n = 261)		
National Institutes of Health NIH USA	25	6.51
United States Department of Health and Human Services	25	6.51
Nih National Cancer Institute (NCI)	24	6.25
National Natural Science Foundation of China (NSFC)	19	4.95
Ministry of Education Culture Sports Science and Technology Japan Next	12	3.12
Japan Society for The Promotion of Science	10	2.60
Grants In Aid for Scientific Research Kakenhi	8	2.08
European Commission	6	1.56
NIH National Institute on Aging (NIA)	6	1.56
National Research Foundation of Korea	5	1.30

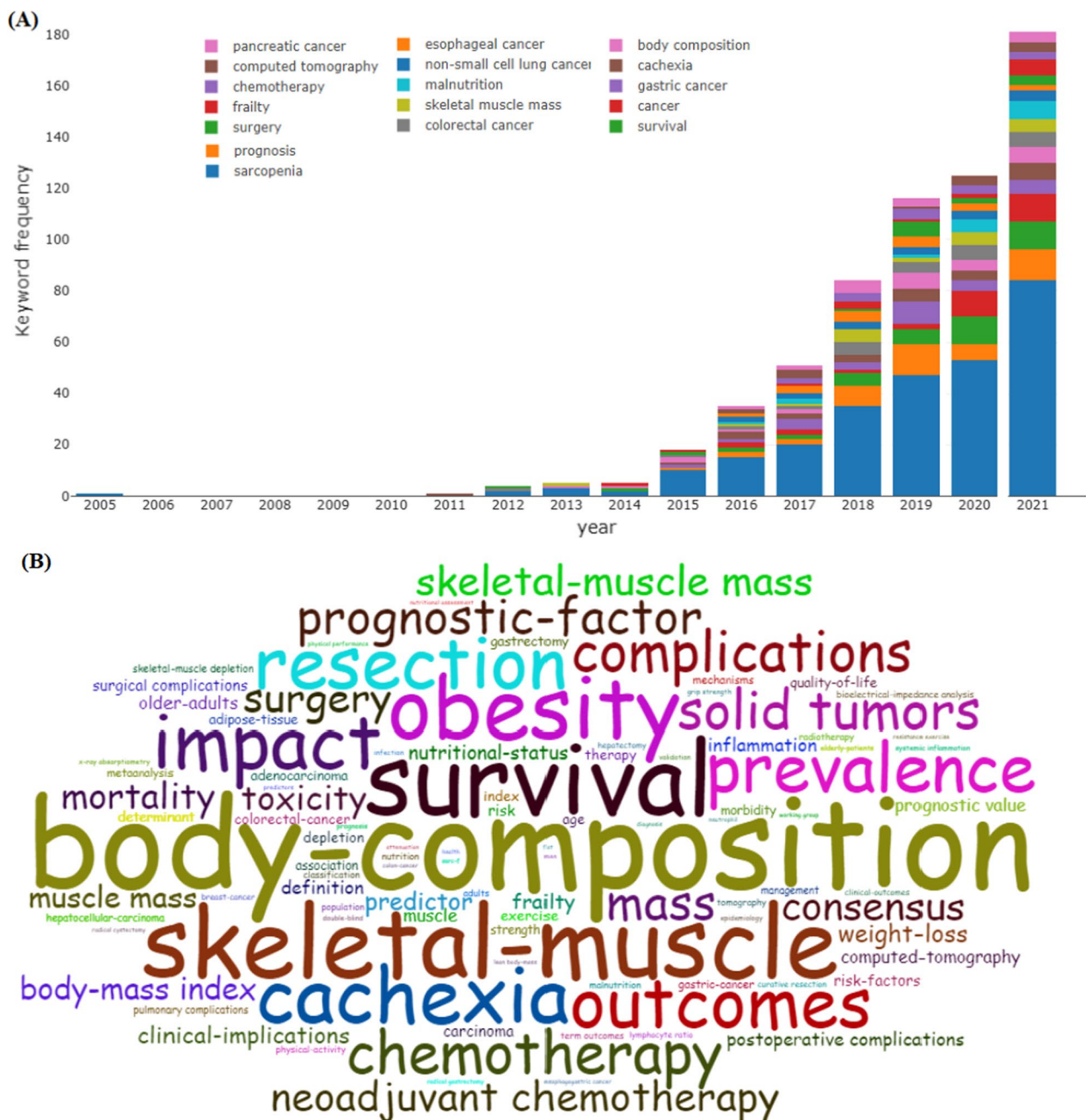


Fig. 4 The annual trends of the top authors' keywords change over the years (A), and the principal 100 frequency occurrences of the keywords plus (B) in sarcopenia in cancer patients

2.2.9 The conceptual structure analysis using a topic dendrogram

Clustering analysis is a technique to understand better the similarity based on the co-occurrence of two keywords. A dendrogram presented in our analysis to shows the relationships between objects associated with each other; here, we display the occurrences of the 50 Authors' Keywords, Keywords Plus, and the title arrangement of

clusters formed by the corresponding analysis, which might successfully reveal the research hotspots and provide research support. Multiple factorial approaches, including multiple corresponding analyses (MCA), are used to reduce data dimensionality. MCA is a new statistical technique gaining attractiveness in the medical field. This method reduces the number of dimensions in data, resulting in two-dimensional visualizations that show the

similarities between data as well as shown in Keywords Plus (Fig. 5A), Authors Keywords (Fig. 5B), and Title (Fig. 5C).

2.2.10 Co-authorship analysis

Co-authorship analysis was analysed using VOS viewer. In total, 121 authors (minimum number of documents of an author: 3) were analysed based on the total Link strength between authors in three clusters (TLS=214) times (Fig. 6B). Yu Zhen (TLS=56), followed by Zhuang Chen-Le (TLS=56), Shen Xian (TLS=51), and Chen Xiao-Lei (TLS=45) times (Fig. 5A). In total, 28 countries (minimum number of documents of an author: 3) were analysed based on the total Link strength between authors in seven clusters (TLS=104) times. The USA is top rank with TLS=33, followed by Germany (TLS=21), Italy (TLS=18), Canada (TLS=16), and Austria (TLS=14), among others (Fig. 6B).

2.3 Discussion

To the authors' knowledge, this is the first bibliometric analysis of sarcopenia and cancer-related research from a document indexed on the Web of Sciences. Science Citation Index Expanded (SCI-EXPANDED) was included. The study aims to provide a comprehensive overview of the global sarcopenia and cancer-related research knowledge structure and research hotspots in the fields from 2005 to 2021, of 384 published articles reported. The trend analysis has seen an explosion in sarcopenia and cancer research, covering many research areas, including Oncology, Surgery, and Nutrition Dietetics. The significant development in the field contributed to over 172 academic journals, 2525 authors from more than 32 corresponding author's countries, and 15.36 International collaborations between the co-authorships within this field.

In our study, the result illustrated little more active scientific research productivity globally between the years 2005–2012. The number of sarcopenia and cancer research publications has risen recently, in particular from 2015 to 2021. This trend suggests that sarcopenia and cancer research development has rapidly progressed and attracted more interest in the global scientific medical society. Thus, the finding confirms the previously published study on international sarcopenia research, which shows the rapid increase in publications over the past years from 2001 to 2020 [45].

The increasing number of articles published annually may be the fund support to enhance the global scientific sarcopenia and cancer research publications. The findings of the top 10 leading articles, within them two highly cited research, provide an overview of sarcopenia and its association with body mass index (BMI) in renal cancer

patients [46] and obesity associated with adverse prognostic factors in pancreatic cancer [18]. Published articles with the highest citation frequency are related to correlating academic impacts in sarcopenia and cancer-related research field. Comprehensive information refereed to the top ten most frequently cited articles on sarcopenia and cancer-related research is provided in Table 2, and the association between different types of cancer are also reported, such as Breast Cancer, Pancreatic Cancer, Colorectal cancer, Gastric Cancer, Bladder Cancer, and other factors such as Cancer-associated malnutrition, and body mass index [16–19, 46–51].

The findings of the analyses show the most prolific countries confirmed that highly contributed to sarcopenia and cancer research publications are being conducted worldwide. More importantly, Japan is listed among the world's top-ranking corresponding author countries, followed by China and the USA. Thus findings reflect the outcome of the other published work where the USA is the top leading research country in global research trends in sarcopenia [45]. In addition, the findings show that most funds for research originated from the National Institutes of Health, which has supported research in this field.

Our analyses of the most prolific institutions confirmed that sarcopenia and cancer-related research are being conducted worldwide. More importantly, Wenzhou Medical University, China, is the first-world institution that contributes the most to sarcopenia and cancer-related. These may be the most developing countries with significant institutions and funding organizations that have supported research in this field to enhance research development.

On the other hand, understanding the characteristics of highly cited studies in a journal could guide the authors who desire to submit and publish their work efficiently. It is the most popular accepted method to assess the qualities of a particular field.

The data from this study indicated that 172 peer review journals related to the subject contributed to the publishing of 384 articles. *Annals of surgical oncology* and *Clinical Nutrition* was the leading journal with more than ten articles. Most of the 96.35% of the research was published in *Oncology*, *Surgery*, *Nutrition Dietetics*, *Gastroenterology hepatology*, and *general medicine Internal*. The analysis also shows the cooperation degree and cooperation between countries based on the links between the reported countries (Fig. 3B).

Despite its first comprehensive bibliometric study on global sarcopenia and cancer-related publication indexed in the Web of Sciences Database, our study has some limitations on the methodological quality of our study, which can be considered as scope for future research for

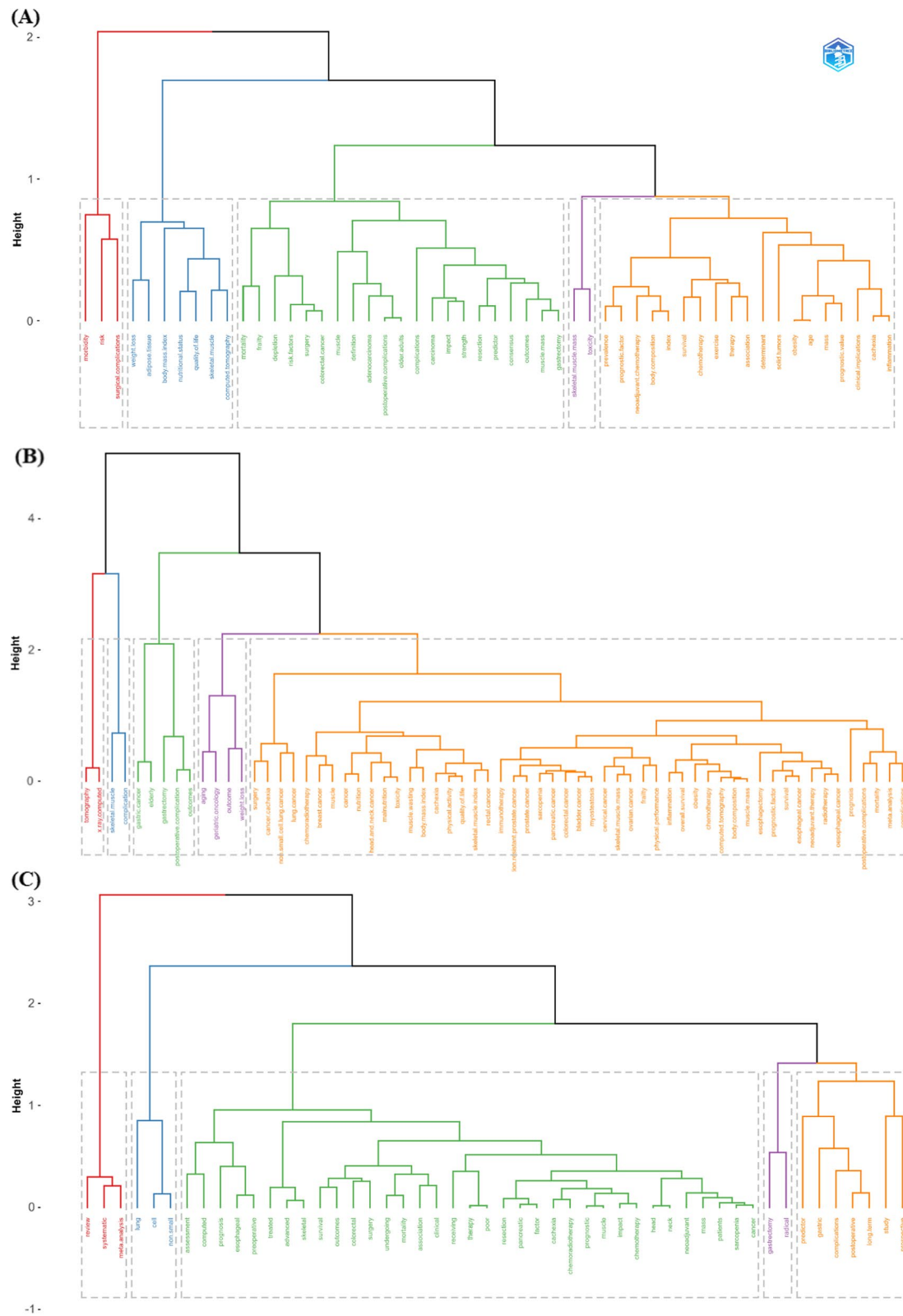


Fig. 5 Topic dendrogram using multiple correspondence analysis (MCA) of keywords plus (A), authors keywords (B), and title (C) that shows the hierarchical relationship between topics in the identified field

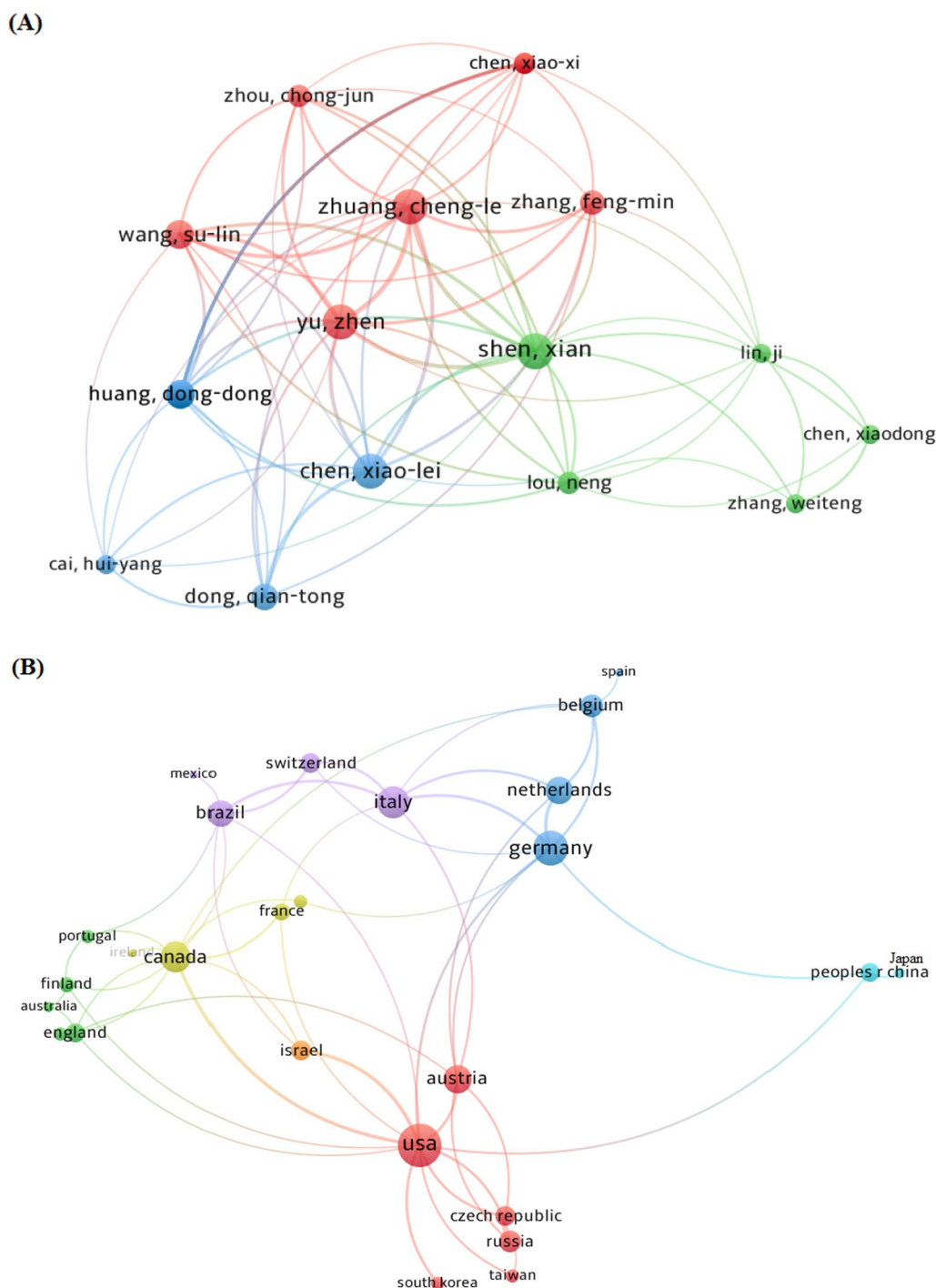


Fig. 6 Co-authorship analysis by units of authors (A) and countries (B) based on the total link strength (TLS)

those interested in the field. First, this study screened the WOS database for global sarcopenia and cancer-related publications. Therefore, this study did not include articles not indexed in Scopus, Google, and PubMed. In the future, researchers may need to consider those databases.

Second, we include articles published in English, so we have yet to include other document types published in non-English in the analysis. Thus, in the future, researchers must also consider including other languages. Thirds, we excluded publications of the year 2022 from the study.

In the future, therefore, we need also to consider the period and pay much more attention to sarcopenia and cancer latest publications.

3 Conclusion

In this study, we assessed the global sarcopenia and cancer-related publication indexed in the Web of Sciences database published from 2005 to 2021 to provide detailed information on sarcopenia and cancer-related publication for interested scientists and scholars globally. Regarding our results, developing nations are lagging in sarcopenia and cancer-related publications with active research productivity after 2014, and more efforts were shown compared to the period from 2005 to 2013. Developed countries such as Japan, China, the USA, Korea, France, Italy, the UK, Netherlands, Turkey, and Brazil played a significant role in publications, contributing to 82.29% of the publications. Our study provides profound insights into sarcopenia's research history, current status, and cancer-related publications, which may indicate its future trend. The countries and collaboration analysis were imbalanced, and there needed better interaction between developing and developed countries or regions, institutions and authors. Therefore, it is vital to strengthen international academic collaboration regarding global sarcopenia and cancer-related publication.

Abbreviations

WOS	Web of science
USA	United States of America
PCM	Protein-calorie malnutrition (PCM)
IL-6	Interleukin-6 secretion
NF- κ B	Nuclear factor- κ B
TNF- α	Tumour necrosis factor alpha
SCI-Expanded	Science citation index expanded
SCP	Single-country publication collaboration
MCP	Multiple-country publications
JIF	Top impact factor
NCI	National cancer institute
NSFC	National Natural Science Foundation of China
NIA	National institute on aging
TLS	Total link strength

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Author contributions

MM contributed to the conceptualization, data curation and methodology; JL was involved in the project administration and supervision; MM assisted in writing—original draft; MM and JL contributed to writing—review and editing. Both authors read and approved the final manuscript.

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Availability of data and materials

All data generated or analysed during this study are included in this published article.

Declarations

Ethics approval and consent to participate

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Consent for publication

Not applicable.

Competing interests

All authors declare that they have no competing interests.

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References

- (2017) Global, regional, and national age-sex specific mortality for 264 causes of death, 1980–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* (London, England), 390(10100): 1151–1210 [https://doi.org/10.1016/S0140-6736\(17\)32152-9](https://doi.org/10.1016/S0140-6736(17)32152-9)
- Miller KD et al (2016) Cancer treatment and survivorship statistics. *CA Cancer J Clin* 66(4):271–289. <https://doi.org/10.3322/caac.21349>
- Miller KD et al (2022) Cancer treatment and survivorship statistics. *CA Cancer J Clin* 72(5):409–436. <https://doi.org/10.3322/caac.21731>
- Musa IH et al (2022) Artificial intelligence and machine learning in cancer research: a systematic and thematic analysis of the top 100 cited articles indexed in scopus database. *Cancer Control* 29:10732748221095946. <https://doi.org/10.1177/10732748221095946>
- Gangadharan A et al (2017) Protein calorie malnutrition, nutritional intervention and personalized cancer care. *Oncotarget* 8(14):24009–24030. <https://doi.org/10.18632/oncotarget.15103>
- Davis MP, Panikkar R (2019) Sarcopenia associated with chemotherapy and targeted agents for cancer therapy. *Ann Palliat Med* 8(1):86–101. <https://doi.org/10.21037/apm.2018.08.02>
- Larsson L et al (2019) Sarcopenia: aging-related loss of muscle mass and function. *Physiol Rev* 99(1):427–511. <https://doi.org/10.1152/physrev.00061.2017>
- Ferrucci L et al (2002) Change in muscle strength explains the accelerated decline of physical function in older women with high interleukin-6 serum levels. *J Am Geriatr Soc* 50(12):1947–1954. <https://doi.org/10.1046/j.1532-5415.2002.50605.x>
- Baracos VE (2018) Cancer-associated malnutrition. *Eur J Clin Nutr* 72(9):1255–1259. <https://doi.org/10.1038/s41430-018-0245-4>
- Cruz-Jentoft AJ et al (2019) Sarcopenia: revised European consensus on definition and diagnosis. *Age Ageing* 48(1):16–31. <https://doi.org/10.1093/ageing/afy169>
- Johal J et al (2022) Dietary supplements in people with metastatic cancer who are experiencing malnutrition, cachexia, sarcopenia, and frailty: a scoping review. *Nutrients* 14:13. <https://doi.org/10.3390/nu14132642>
- Struve S, Ringwald J (2019) Anticoagulation in patients with cancer. *Laryngorhinootologie* 98(1):21–26. <https://doi.org/10.1055/a-0790-0834>
- Ciulla M, Marinelli L, Cacciatore I, Di Stefano A (2019) Role of dietary supplements in the management of Parkinson's disease. *Biomolecules* 9:7. <https://doi.org/10.3390/biom9070271>
- Cao A, Ferrucci LM, Caan BJ, Irwin ML (2022) Effect of exercise on sarcopenia among cancer survivors: a systematic review. *Cancers* (Basel) 14(3):786. <https://doi.org/10.3390/cancers14030786>
- Argilés JM (2005) Cancer-associated malnutrition. *Eur J Oncol Nurs Off J Eur Oncol Nurs Soc* 9(Suppl 2):S39–50. <https://doi.org/10.1016/j.ejon.2005.09.006>
- Prado CMM et al (2009) Sarcopenia as a determinant of chemotherapy toxicity and time to tumour progression in metastatic breast cancer patients receiving capecitabine treatment. *Clin Cancer Res* 15(8):2920–2926. <https://doi.org/10.1158/1078-0432.CCR-08-2242>

17. Liefers JR, Bathe OF, Fassbender K, Winget M, Baracos VE (2012) Sarcopenia is associated with postoperative infection and delayed recovery from colorectal cancer resection surgery. *Br J Cancer* 107(6):931–936. <https://doi.org/10.1038/bjc.2012.350>
18. Tan BHL, Birdsell LA, Martin L, Baracos VE, Fearon KCH (2009) Sarcopenia in an overweight or obese patient is an adverse prognostic factor in pancreatic cancer. *Clin Cancer Res* 15(22):6973–6979. <https://doi.org/10.1158/1078-0432.CCR-09-1525>
19. Ryan AM, Power DG, Daly L, Cushen SJ, Bhuachalla EN, Prado CM (2016) Cancer-associated malnutrition, cachexia and sarcopenia: the skeleton in the hospital closet 40 years later. *Proc Nutr Soc* 75(2):199–211. <https://doi.org/10.1017/S002966511500419X>
20. Onasanya AK et al (2022) Bibliometric analysis of 100 top-cited articles on neem indexed in the web of science. *Trop J Nat Prod Res* 6(1):95–108. <https://doi.org/10.26538/tjnpr/v6i1.17>
21. Musa TH, Akintunde TY, Musa IH, Mohammed LA, Tassang AE, Musa HH (2022) Rift valley fever: a thematic analysis of documents indexed in the web of science core collection database. *Ann Infect*. <https://doi.org/10.21037/Aoi-21-9>
22. Helmy M, Akintunde TY, Musa TH (2021) Global research evidence on COVID-19- and anxiety: a bibliometric analysis. *AGJSR* 39:60–78
23. Kawuki J, Musa TH, Ghimire U, Obore N, Papabathini SS (2022) The 100 top-cited articles on childhood obesity: a bibliometric analysis. *Glob Heal J*. <https://doi.org/10.1016/j.glohj.2022.07.003>
24. Akintunde TY et al (2021) Bibliometric analysis of global scientific literature on effects of COVID-19 pandemic on mental health. *Asian J Psychiatr* 63:102753. <https://doi.org/10.1016/j.ajp.2021.102753>
25. Musa TH, Li W, Kawuki J, Wei P (2021) The 100 top-cited articles on scrub typhus: a bibliometric analysis. *Osong Public Health Res Perspect* 12(2):126–135
26. Gatasi G, Musa TH, Odjidja EN (2021) Bibliometric analysis of the top 100 cited articles on HIV/AIDS. *Ann Infect* 5:6–6. <https://doi.org/10.21037/Aoi-20-17>
27. Kawuki J, Musa TH, Papabathini SS, Ghimire U, Obore N, Yu X (2021) The 100 top-cited studies on ebola: a bibliometric analysis. *Electron J Gen Med*. <https://doi.org/10.29333/ejgm/9694>
28. Musa TH, Akintunde TY, Gatasi G, Ghimire U, Kawuki J, Musa HH (2021) A bibliometric analysis of the 100 top-cited articles on global malnutrition indexed in Web of Science. *J Public Heal Emerg*. <https://doi.org/10.21037/jphe-21-38>
29. Musa IH, Musa TH, Musa HH, Balilla RMH, Ahmed ME (2021) Bibliometric analysis of the top 50 most-cited articles of esophagus cancer. *J Tumor* 9(1):572–578. <https://doi.org/10.17554/j.issn.1819-6187.2021.09.126>
30. Kawuki J, Yu X, Musa TH (2020) Bibliometric analysis of Ebola research indexed in web of science and Scopus (2010–2020). *Biomed Res Int*. <https://doi.org/10.1155/2020/5476567>
31. Musa TH, Hassan H, El-Sharief M, Idriss HM, Akintunde TY (2021) Global scientific research output on sickle cell disease : a comprehensive bibliometric analysis of web of science publication. *Sci Afr* 12:e00774
32. Akintunde TY et al (2021) Tracking the progress in COVID-19 and vaccine safety research—a comprehensive bibliometric analysis of publications indexed in Scopus database. *Hum Vaccines Immunother*. <https://doi.org/10.1080/21645515.2021.1969851>
33. Sánchez AD, de la Del Rio MC, Garcia JÁ et al (2017) Bibliometric analysis of publications on wine tourism in the databases Scopus and WoS. *Eur Res Manag Bus Econ* 23(1):8–15
34. Moodley J, Singh V, Kagina BM, Abdullahi L, Hussey GD (2015) A bibliometric analysis of cancer research in South Africa: study protocol. *BMJ Open* 5(2):e006913
35. Zhai X et al (2017) Global research trends in spinal ultrasound: a systematic bibliometric analysis. *BMJ Open* 7(10):e015317
36. Musa IH, Musa TH, Zamit I, Okeke M (2021) Artificial intelligence and machine learning in oncology: historical overview of documents indexed in the web of science database. *Eurasian J Med Oncol* 5(3):239–248. <https://doi.org/10.14744/ejmo.2021.24856>
37. Musa HH, Musa TH, Musa IH, Musa IH (2021) Global scientific research progress in mycetoma: a bibliometric analysis. *Trans R Soc Trop Med Hyg*. <https://doi.org/10.1093/trstmh/tra072>
38. Akintunde TY et al (2021) Web of Science and Scopus: a comprehensive bibliometric analysis Mapping the global research output on Ebola vaccine from research indexed in web of science and Scopus : a comprehensive bibliometric analysis. *Hum Vaccine Immunother*. <https://doi.org/10.1080/21645515.2021.1948785>
39. Musa TH, Musa IH, Osman W, Campbell MC, Musa HH (2021) A bibliometric analysis of global scientific research output on Gum Arabic. *Bioact Carbohydr Diet Fibre* 25:100254. <https://doi.org/10.1016/j.bcdf.2020.100254>
40. Musa TH, Akintunde TY, Musa IH, Mohammed LA, Tassang AE, Musa HH (2022) Rift valley fever: a thematic analysis of documents indexed in the Web of Science core collection database. *Ann Infect* 6:1. <https://doi.org/10.21037/Aoi-21-9>
41. Kawuki J, Ghimire U, Papabathini SS, Obore N, Musa TH (2021) A bibliometric analysis of childhood obesity research from China indexed in Web of Science. *J Public Heal Emerg*. <https://doi.org/10.21037/jphe-20-95>
42. Musa TH, Akintunde TY (2021) Original paper global scientific research output on sickle cell disease: a comprehensive bibliometric analysis of web of science publication. *Sci Afr*. <https://doi.org/10.1016/j.sciaf.2021.e00774>
43. Dervis H (2019) Bibliometric analysis using bibliometric an R package. *J Scientometr Res* 8(3):156–160. <https://doi.org/10.5530/JSCIRES.8.3.32>
44. van Eck NJ, Waltman L (2010) Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*. <https://doi.org/10.1007/s11192-009-0146-3>
45. Yuan D et al (2022) Publication trends for sarcopenia in the world: a 20-year bibliometric analysis. *Front Med* 9:802651. <https://doi.org/10.3389/fmed.2022.802651>
46. Huillard O et al (2013) Sarcopenia and body mass index predict sunitinib-induced early dose-limiting toxicities in renal cancer patients. *Br J Cancer* 108(5):1034–1041. <https://doi.org/10.1038/bjc.2013.58>
47. Reisinger KW et al (2015) Functional compromise reflected by sarcopenia, frailty, and nutritional depletion predicts adverse postoperative outcome after colorectal cancer surgery. *Ann Surg* 261(2):345–352. <https://doi.org/10.1097/SLA.0000000000000628>
48. Zhuang C-L et al (2016) Sarcopenia is an independent predictor of severe postoperative complications and long-term survival after radical gastrectomy for gastric cancer: analysis from a large-scale cohort. *Med (United States)* 95(13):e3164. <https://doi.org/10.1097/MD.00000000000003164>
49. Miyamoto Y et al (2015) Sarcopenia is a negative prognostic factor after curative resection of colorectal cancer. *Ann Surg Oncol* 22(8):2663–2668. <https://doi.org/10.1245/s10434-014-4281-6>
50. Feliciano EMC et al (2017) Association of systemic inflammation and sarcopenia with survival in nonmetastatic colorectal cancer: results from the C SCANS study. *JAMA Oncol* 3(12):e172319. <https://doi.org/10.1001/jamaoncol.2017.2319>
51. Psutka SP et al (2014) Sarcopenia in patients with bladder cancer undergoing radical cystectomy: impact on cancer-specific and all-cause mortality. *Cancer* 120(18):2910–2918. <https://doi.org/10.1002/cncr.28798>

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