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A bibliometric analysis of malnutrition in the geriatric population

Duygu Tutan[1], Suna Bürkük[2]

[1]Department of Internal Medicine, Hitit University Çorum Erol Olçok Training and Research Hospital, Çorum, Turkey
[2]Department of Geriatrics, Hitit University Çorum Erol Olçok Training and Research Hospital, Çorum, Turkey

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ABSTRACT

Aim: Malnutrition is a significant issue in the geriatric population. The frequency of infections, morbidity, and mortality rates are higher in malnourished patients. The purpose of this research is to evaluate scientific articles on geriatric malnutrition using statistical methods and to evaluate the topic from a novel viewpoint.

Material and Method: Statistical and bibliometric techniques were used to examine articles on geriatric malnutrition published between 1980 and 2022 in the Web of Science database. For correlation analyses, the Spearman correlation coefficient was used. To predict the number of publications in the subsequent years, a nonlinear (exponential growth model) regression analysis was performed. Trending subjects and connections were identified using keyword network visualization maps.

Results: Within the search criteria, 595 publications on geriatric malnutrition were identified between 1980 and 2022. 427 of those (articles and reviews) were included in the analysis. Since 2005, the quantity of published materials on the issue has expanded dramatically and continues to rise. The most active countries were USA and Spain, the most active author was Volkert, D., and the most active journal on the subject was Clinical Nutrition.

Conclusion: This research on geriatric malnutrition explores 427 publications, their origin countries, authors, and most used keywords. Geriatric malnutrition is one of the current trending research topics and seems more relevant every year in the aging world. This article may help physicians' and scientists' understanding of worldwide efforts on geriatric malnutrition.

Keywords: Geriatric, malnutrition, elderly, bibliometrics

INTRODUCTION

Malnutrition is a significant issue, particularly among cancer patients, intensive care patients, patients requiring major surgery, and especially in the geriatric population (1). As the geriatric population continues to rise, providing them with better healthcare is vital. In order to reduce the chance of developing chronic illnesses, a balanced diet and physical activity are frequently emphasized in older adults' nutrition. However, most research in geriatric nutrition suggests that protein-energy malnutrition (PEM) is a prevalent problem in this age range, especially in communities, hospitals, and nursing homes. Multicentre studies assessing the prevalence of PEM in acute care settings indicate that 23–60% of elderly patients are malnourished, and an estimated 22–28% are at nutritional risk (2,3).

Multiple organ systems, including the digestive tract, kidneys, heart, and lungs, can be negatively affected by malnutrition. In parallel with the deterioration of muscular strength and immunological function in malnourished elderly individuals, the risk of injury, the rate of chronic wounds, the frequency of infections, morbidity, and inevitably, the risk of mortality may rise (4). All of these issues can contribute to prolonged hospital stays and higher medical expenses (5).

2012 consensus statement from the Academy of Nutrition and Dietetics and the American Society for Parenteral and Enteral Nutrition (ASPEN) recommends diagnostic criteria for the diagnosis of malnutrition. The following diagnostic criteria indicate malnutrition if two or more criteria exist; insufficient energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, localized or generalized fluid accumulation that may mask weight loss, diminished functional status as measured by handgrip strength (6). In 2018 European Society for Clinical Nutrition and Metabolism (ESPEN) suggested a new criterion for malnutrition. In this criterion, before a diagnosis of malnutrition can be made, the patient must be determined as "at nutritional risk" by any validated nutritional risk screening method. Any of two sets of diagnostic criteria will confirm the malnutrition diagnosis. These criteria are; reduced body mass index (BMI) <18.5 kg/m2, combined weight loss and reduced BMI (age-related BMI), and reduced gender-dependent fat-free mass index (FFMI) (7).

Corresponding Author: Duygu Tutan, duygus_781@hotmail.com

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The Global Leadership Initiative on Malnutrition (GLIM) announced new standards in 2018. The GLIM was established to develop a worldwide consensus on the identification and diagnostic criteria for malnutrition to compare malnutrition's prevalence, treatment, and consequences accurately. The revised criteria incorporate an understanding of the significance of acute and chronic inflammation and use at least one phenotype and one etiologic criterion to diagnose malnutrition (8).

Malnutrition can be classified as disease-related malnutrition with inflammation, disease-related malnutrition without inflammation, and malnutrition/undernutrition without disease (7). Cachexia is a complex metabolic condition marked by muscle loss with or without fat loss because of an underlying disease and associated with higher morbidity (9). It is often accompanied by inflammation, insulin resistance, accelerated muscle protein breakdown, and anorexia.

Studies based on statistical and bibliometric analyses have been conducted on various important medical topics in conjunction with the rise in publications in recent years. When combined with thorough statistical methodologies, bibliometric studies provide researchers with ideas and breakthroughs for new research by revealing previous and present patterns (10,11). In recent years, the number of publications on geriatric malnutrition has steadily increased, and awareness has risen with each article.

Even though the number of global research on elderly malnutrition has increased over the past several years, only one bibliometric study has been published (12). The purpose of this study was to evaluate studies on geriatric malnutrition published between 1980 and 2022 using bibliometric and statistical methods. As a result of the analyses, we intend to identify the most influential studies, journals, authors, institutions, and countries on geriatric malnutrition, reveal cooperation between countries, reveal past and present trend issues, and provide a comprehensive summary of malnutrition in the elderly population.

MATERIAL AND METHOD

Ethics committee approval is not required in this bibliometric study.

This research was conducted in accordance with the World Medical Association Declaration of Helsinki's "Ethical Principles for Medical Research Involving Human Subjects."

Clarivate Analytics' Web of Science (WoS) database was used for the literature review. In WoS, the search terms "geriatric malnutrition," "geriatr*" AND "malnutri*," and "malnutrition AND "elderly" were used. Only the "title" section of the studies was used for the publication search. Using this search technique, all papers on elderly malnutrition, geriatric malnutrition, or articles containing terms derived from "geriatr*" and "malnutri*" in the title was found and retrieved from the WoS database. The search dates were determined to be between 1980 and 2022 (access date: 29.12.2022). Researchers can use these reproducibility codes to access comparable documents (search results may differ based on access dates): ("Geriatric malnutrition" (Title) OR "malnutrition" AND "elderly" (Title) OR "geriat*" AND "malnutri*" (Title) Timespan: 1980-2022 (Indexes Scanned: SCI-Expanded, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI)). For bibliometric network visualization, VOSviewer (Version 1.6.18, Leiden University's Center for Science and Technology Studies) software was used (13). The Tableau Software for Windows (Version 2019.4.1.; Tableau Software LLC, Seattle, WA) software was used to create a globe map.

Statistical analyses were performed using the IBM SPSS Statistics for Windows software (Version 26; IBM Corp., Armonk, N.Y., USA). Data normal distribution was evaluated with the Shapiro-Wilks test. In line with the data distribution, Spearman's correlation coefficient was used to assess the relationships between the number of articles published by world nations and multiple economic development indicators of world countries to see whether there is a relationship between economic power and the number of scientific publications (Gross Domestic Product (GDP), and GDP per capita, World Bank, 2021 data) (14). To predict the number of publications in the next years, a nonlinear regression analysis (exponential growth model) was used. In the regression analysis, R square (R2) value was utilized to measure the model's effectiveness. Results were considered statistically significant if the p-value was less than 0.05.

RESULTS

The Web of Science database included 595 papers regarding geriatric malnutrition published between 1980 and 2020. Of these publications, 397 were Articles (66.72%), 114 were Meeting Abstracts (19.16%), 30 were Reviews (5.04%), 29 were Letters (4.87%), 13 were Editorials (2.18%), and 12 (2.02%) were other types of publication (Correction, Proceedings Paper, Note).

397 articles (9 early access articles included) and 30 reviews were subjected to bibliometric analysis. 85.71%

(366) of these publications were in English, 5.62% (24) in Spanish, 4.22% (18) in German, 2.81% (12) in French, and the remaining works were published in different languages (Italian (4), Portuguese (2), Polish (1)).

The average number of citations per article was 24.62, the total number was 10511 (without self-citations: 9816), 57 publications were not cited, and the h-index of 427 articles was 53.

Active Research Areas

The top 10 research areas about geriatric nutrition were Nutrition Dietetics (171, 40.1%), Geriatrics (96, 22.5%), General Internal Medicine (62, 14.5%), Public Environmental Occupational Health (32, 7.5%), Gerontology (29, 6.8%), Nursing (15, 3.5%), Endocrinology Metabolism (12, 2.8%), Cardiac Cardiovascular Systems (8, 1.9%), Healthcare Sciences Services (8, 1.9%), Psychiatry (7, 1.6%).

Development and Future Trends of Publication

Figure 1 illustrates the distribution of the number of published papers by year. It also shows the findings of the non-linear exponential growth regression analysis performed to estimate the number of publications in 2023 and beyond. The model had a statistically significant association with the data, and the degree of agreement between the exponential growth model and the data was 79.5% (R2=0.795, p<0,001). This model predicts that 38 (95% Confidence Interval (CI): 20-73) articles will be published in 2023, 41 (95% CI: 21-79) papers will be published in 2024, and 44 (95% CI: 23-85) articles will be published in 2025 (**Figure 1**).

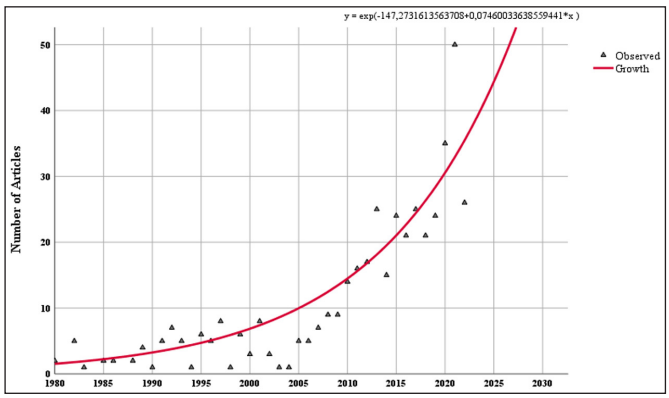

Figure 1. Distribution of geriatric malnutrition publications by year and projection of articles in the next years using the exponential growth model

Active Countries

The top 10 nations with the most papers on geriatric malnutrition were Spain (42, 9.8%), USA (42, 9.8%), France (36, 8.4%), Italy (32, 7.5%), People's Republic of China (30, 7.0%), Germany (29, 6.8%), Turkey (26, 6.0%), Australia (24, 5.6%), Japan (23, 5.4%), Netherlands (19, 4.5%) (**Figure 2**). The total link strength scores of 26 nations that contributed at least five articles to 60 nations' publications on geriatric malnutrition and had international collaboration among their authors were measured. **Figure 3** shows the collaborative clustering network map using these scores (Turkey, Poland, and South Korea did not have author links to any other country and were excluded from the map). According to the results, seven different clusters were formed (Cluster 1: Belgium, Canada, England, France, Japan, Lebanon, Cluster 2: Iran, Norway, Sweden, Taiwan, USA, Cluster 3: Austria, Germany, Netherlands, Cluster 4: Malaysia, People's Republic of China, Singapore, Cluster 5: Brazil, Spain, Cluster 6: Italy, Switzerland, Cluster 7: Australia, India). **Figure 3** also depicts the internal collaboration density map.

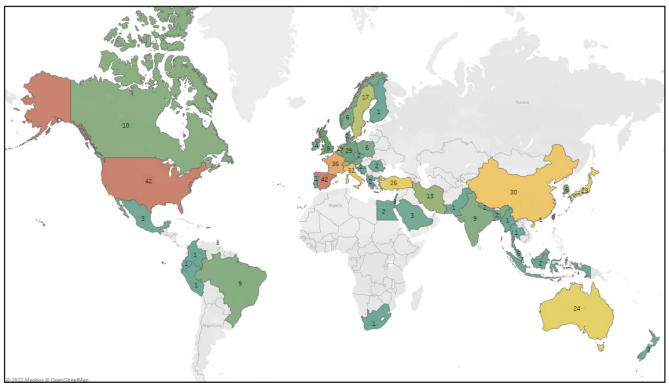

Figure 2. Global distribution of publications on geriatric malnutrition

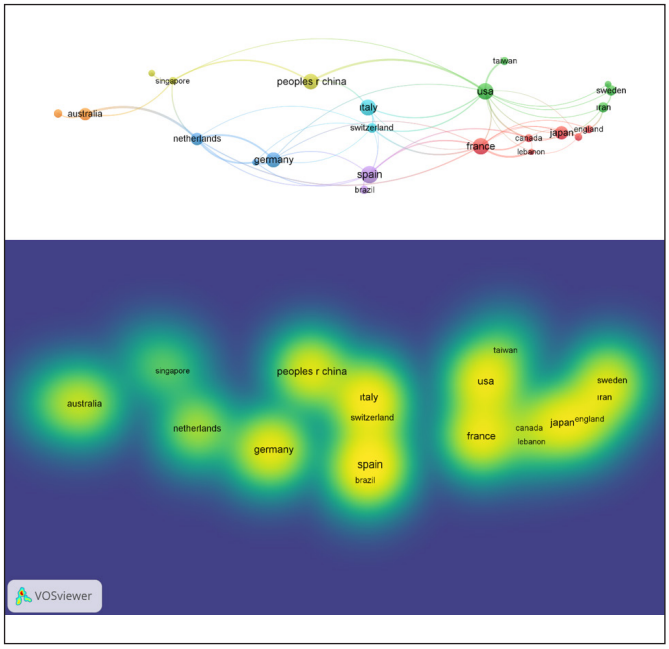

Figure 3. Network visualization map of cluster analysis and density map on worldwide cooperation on geriatric malnutrition

Correlation Analysis of Publication Count and Gross Domestic Product

There was a statistically significant correlation between the number of publications produced by nations on geriatric malnutrition and their Gross Domestic Product (GDP) and GDP per capita (r=0.611, p<0,001; r=0.296, p=0,033).

Active Authors

The top ten most active and prolific authors who have published the most articles on geriatric malnutrition are Volkert D. (11, 2.6%), Sieber CC. (7, 1.6%), Maier AB. (5,1.2%), Miller M. (5, 1.2%), Reijnierse EM. (5, 1.2%), Smoliner C. (5, 1.2%), Eschbach D. (4, 0.9%), Hebuterne X. (4, 0.9%), Isenring E (4, 0.9%), and Lipschitz DA. (4, 0.9%).

Active Institutions

The top ten institutes that generated the most publications on malnutrition in the elderly between the years 1980 and 2022 were UDICE French Research Universities (16, 3.7%), University of Erlangen Nuremberg (10, 2.3%), Vrije Universiteit Amsterdam (9, 2.1%), Assistance Publique Hopitaux Paris (8, 1.9%), Institut National de la Sante et de la Recherche Medicale Inserm (8, 1.9%), Tehran University of Medical Sciences (8, 1.9%), University of Melbourne (8, 1.9%), Flinders University South Australia (7, 1.6%), Royal Melbourne Hospital (6, 1.4%), Universite Paris Cite (6, 1.4%).

Active Journals

A total of 427 publications about geriatric malnutrition have been published in 218 distinct journals. **Table 1** includes the top 40 journals that published four or more articles, the total number of citations received by the journals, and the average number of citations per article.

Citation Analysis

Table 2 displays the 20 papers with the highest citation count among the 427 articles published between 1980 and 2022. The annual average number of citations is then presented in the final column of **Table 2**.

Co-citation Analysis

The reference sections of all 427 examined publications included a total of 10,570 studies. The top 10 publications with the highest number of co-citations (above 20) were as follows: Kondrup (2003) (Number of co-citations (NC): 69), Rubenstein (2001) (NC: 51), Vellas (1999) (NC: 49), Kaiser (2010) (NC: 47), Guigoz (1996) (NC: 40), Guigoz (2006) (NC: 39), Folstein (1975) (NC: 34), Guigoz (2002) (NC: 33), Cederholm (2015) (NC: 33), Kaiser (2009) (NC: 32).

Trending Topics

In the 427 publications published on geriatric malnutrition, 697 unique keywords were used. **Figure 4** presents the cluster network visualization for 62 keywords that appeared in at least four independent publications. **Figure 4** also depicts a network map for trend visualization and a network map for citation visualization for those 62 keywords.

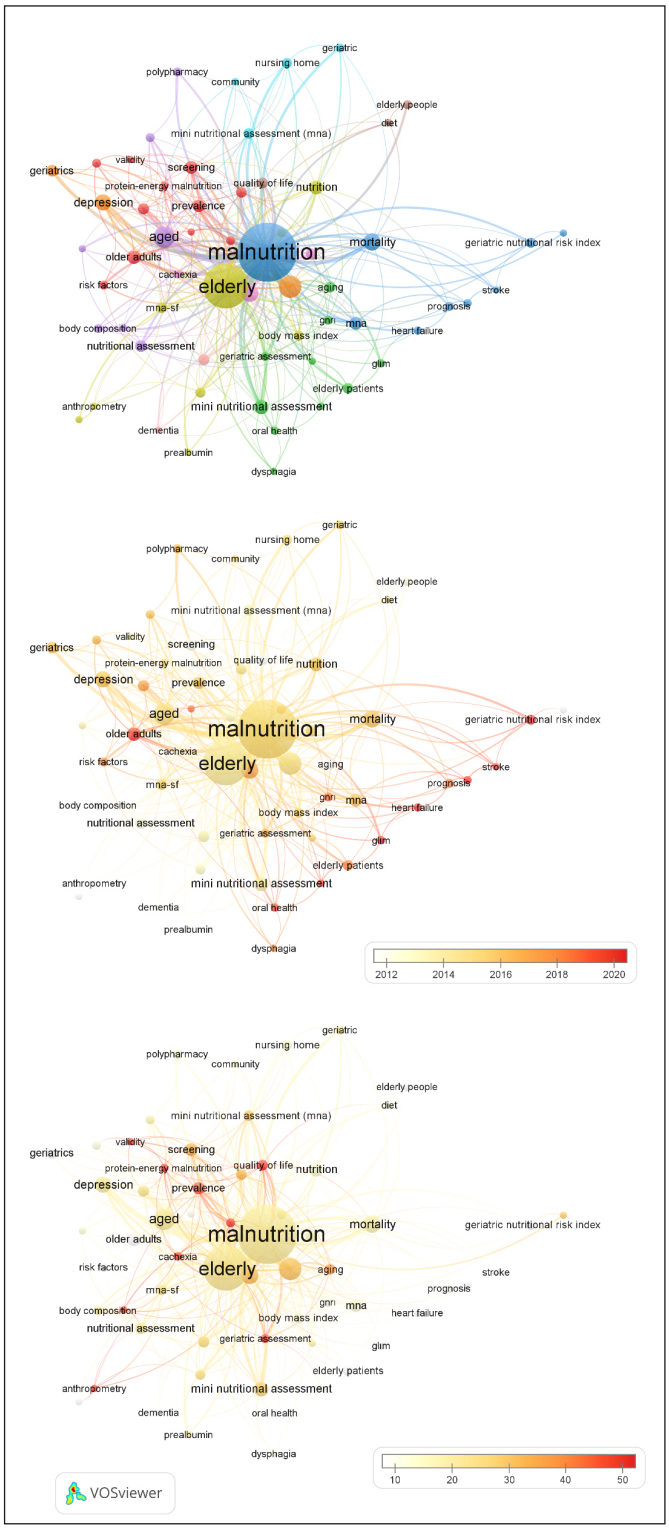

Figure 3. Keyword cluster analysis, keyword trend, and citation network visualization map of geriatric malnutrition

Table 1. The top 40 most active journals with articles on geriatric malnutrition (RC: Record Count, C: Number of Citations, AC: Average Citation per Manuscript)

Journals	RC	C	AC	Journals	RC	C	AC
Clinical Nutrition	23	1453	148.18	Zeitschrift fur Gerontologie und Geriatrie	4	42	3.38
Journal of Nutrition Health & Aging	19	733	65.1	Geriatrics & Gerontology International	4	45	7.6
Nutrients	16	151	74.7	Clinical Nutrition Espen	4	46	9
Nutricion Hospitalaria	12	188	19.43	BMC Geriatrics	4	31	6.83
Nutrition	10	379	20.58	British Journal of Nutrition	4	339	22.84
European Journal of Clinical Nutrition	10	423	71.77	Iranian Journal of Public Health	4	68	8.41
Asia Pacific Journal of Clinical Nutrition	9	109	14.18	Plos One	3	68	11.12
Journal of the American Geriatrics Society	7	519	18.42	Journals of Gerontology Series A-Biological Sciences and Medical Sciences	3	132	7.4
Aging Clinical and Experimental Research	7	88	11.69	Journal of the Academy of Nutrition and Dietetics	3	80	11.6
Nutricion Clinica Y Dietetica Hospitalaria	6	6	1.56	BMJ Open	3	76	15.19
Age and Ageing	6	310	12.63	Nutrition & Dietetics	3	65	7.15
Archives of Gerontology and Geriatrics	5	126	14.21	Experimental Gerontology	3	12	3.5
Nutrition Clinique et Metabolisme	5	5	1.55	International Journal of Nursing Studies	3	116	12.58
Clinical Interventions in Aging	5	52	8.94	Journal of Advanced Nursing	3	253	10.92
Public Health Nutrition	5	106	13.73	Ciencia & Saude Coletiva	2	17	2.25
Progress in Nutrition	5	6	2	Journal of the American College of Nutrition	2	76	6.37
European Geriatric Medicine	5	60	12.52	Gerontology	2	56	4.13
Medicina Clinica	5	100	4.83	International Journal of Environmental Research and Public Health	2	10	3.33
Australian and New Zealand Journal of Medicine	4	29	1.12	Journal of the American Medical Directors Association	2	208	17.32
Frontiers in Nutrition	4	31	6.5	International Journal of Food Sciences And Nutrition	2	8	0.3

Table 2. The top 20 most cited articles on geriatric malnutrition according to total citations (PY: Publication year, TC: Total citation count, AC: Average citations per year)

No	Article	Author Journal	PY	TC	AC
1	Identifying the elderly at risk for malnutrition - The Mini Nutritional Assessment	Guigoz, Y et al. Clinics in Geriatric Medicine	2002	611	29.1
2	Protein and energy supplementation in elderly people at risk from malnutrition	Milne, Anne C. Cochrane Database of Systematic Reviews	2009	356	25.4
3	Malnutrition in the elderly: A narrative review	Agarwal, E. Maturitas	2013	256	25.6
4	'Malnutrition Universal Screening Tool' predicts mortality and length of hospital stay in acutely ill elderly	Stratton, RJ British Journal of Nutrition	2006	230	13.5
5	Malnutrition in the elderly and its relationship with other geriatric syndromes	Saka, Bulent Clinical Nutrition	2010	199	15.3
6	A concept analysis of malnutrition in the elderly	Chen, CCH Journal of Advanced Nursing	2001	191	8.68
7	Malnutrition in institutionalized elderly - how and why	Keller, HH Journal of The American Geriatrics Society	1993	175	5.83
8	Outcome of protein-energy malnutrition in elderly medical patients	Cederholm, T American Journal of Medicine	1995	172	6.14
9	Prevalence of malnutrition and analysis of related factors in elderly patients with COVID-19 in Wuhan, China	Li, Tao European Journal of Clinical Nutrition	2020	157	52.3
10	Protein-energy malnutrition in elderly medical patients	Constans, T Journal of The American Geriatrics Society	1992	151	4.87
11	Malnutrition and depression among community-dwelling elderly people	Sarria Cabrera, Marcos Aparecido Journal of The American Medical Directors Association	2007	139	8.69
12	Sarcopenia and malnutrition in acutely ill hospitalized elderly: Prevalence and outcomes	Cerri, Anna Paola Clinical Nutrition	2015	127	15.9
13	Undiagnosed malnutrition and nutrition-related problems in geriatric patients	Volkert, D. Journal of Nutrition Health & Aging	2010	117	9
14	Understanding the gastrointestinal tract of the elderly to develop dietary solutions that prevent malnutrition	Remond, Didier Oncotarget	2015	114	14.3
15	Malnutrition in elderly: social and economic determinants	Donini, L. M. Journal of Nutrition Health & Aging	2013	110	11
16	Effects of food fortification on nutritional and functional status in frail elderly nursing home residents at risk of malnutrition	Smoliner, Christine Nutrition	2008	108	7.2
17	Prevalence and determinants for malnutrition in geriatric outpatients	van Bokhorst-de van der Schueren, Marian A. E. Clinical Nutrition	2013	106	10.6
18	Evaluation of the efficacy of six nutritional screening tools to predict malnutrition in the elderly	Poulia, Kalliopi-Anna Clinical Nutrition	2012	103	9.36
19	Malnutrition and associated factors in elderly hospital patients: A Belgian cross-sectional, multicentre study	Vanderwee, Katrien Clinical Nutrition	2010	102	7.85
20	Malnutrition in the hospitalized geriatric-patient	Bienia, R Journal of The American Geriatrics Society	1982	97	2.37

DISCUSSION

Malnutrition is described as a deficit, excess, or imbalance of energy, protein, and other nutrients that produce observable detrimental consequences on tissue shape and function, as well as clinical outcomes. Malnutrition is a geriatric syndrome that is frequently seen in up to 50% of the geriatric population (15). Geriatric malnutrition is associated with increased morbidity and mortality, and early identification of individuals at risk is favorable for minimizing morbidity and mortality, hospitalization requirements, and expenses (16,17).

Malnutrition in geriatric patients is a crucial healthcare problem, especially in developed and aging countries. However, our research data shows that between 1980 and 2005, there were not many publications on malnutrition in the aging population. Especially compared to other similar research areas like total parenteral nutrition, geriatric malnutrition has a small body of knowledge even of this day (18). There has been an upward trend in the publications about geriatric nutrition since 2005, with the sole decrease being in 2022. We attribute this decrease to the pandemic of 2020 and 2021. Evaluation of non-linear regression analysis reveals that the number of publications will continue to increase exponentially in the years to come. With an average citation count of 24.62 citations per article, geriatric nutrition shows its importance even though the total number on this subject is relatively low.

When analyzing the distribution of publications by country, the top 10 countries with the most publications on geriatric malnutrition were all developed nations. This study's correlation analysis shows a substantial link between article productivity and economic development indicators, revealing that economic development level affects geriatric nutrition publication output. In addition, bibliometric studies on various medical topics have been shown in the literature to increase publishing activity (11,19). GDP and GDP per capita are correlated with publication count, but interestingly the correlation is much more robust with GDP than GDP per capita; this suggests that a country's income is more critical than a household's income for scientific publications about geriatric malnutrition.

When the density map was created based on collaboration between nations, the countries with the highest level of cooperation were Spain, Italy, USA, China, and Germany. When the co-authorship of nations on geriatric malnutrition is investigated, it seems that most countries collaborated based on their geographical location (Malaysia-China-Singapore/Germany-Austria-Netherlands/Italy-Switzerland). However, also there were curious clusters like USA-Iran-Norway-Sweden-Taiwan and England-France-Canada-Belgium-Japan-Lebanon. Turkey, South Korea, and Poland were not in cooperation with any other country but had significantly contributed to research and publication.

Clinical Nutrition was the journal with the most published articles to date, followed by Journal of Nutrition Health & Aging, Nutrients, Nutricion Hospitalaria, Nutrition, European Journal of Clinical Nutrition, Asia Pacific Journal of Clinical Nutrition, Journal of the American Geriatrics Society, respectively. When the average number of citations per article for journals was investigated, Clinical Nutrition was again the first journal with the most citations per article (148.18 citations per article). Nutrients, European Journal of Clinical Nutrition, Journal of Nutrition Health & Aging, British Journal of Nutrition, Nutrition, Nutricion Hospitalaria, Journal of the American Geriatrics Society, Journal of the American Medical Directors Association, and BMJ Open were the other nine journals in the top ten most cited journals per article, respectively.

The most cited study was "Identifying the elderly at risk for malnutrition - The Mini Nutritional Assessment" published in Clinics in Geriatric Medicine in 2022 by Guigoz, Y., and had 611 total citations and an average of 29.1 citations per year (20). The second most cited study was "Protein and energy supplementation in elderly people at risk from malnutrition" by Milne, Anne C. in the Cochrane Database of Systematic Reviews, with 356 total citations and an average of 25.4 citations per year (21). The third was "Malnutrition in the elderly: A narrative review" by Agarwal, E., published by Maturitas in 2013, with 256 total citations and an average of 25.6 citations per year (2). However, interestingly, "Prevalence of malnutrition and analysis of related factors in elderly patients with COVID-19 in Wuhan, China" by Li, Tao in European Journal of Clinical Nutrition was the publication with the highest average citation count with 52.3 citations per year after it published (22), we attribute this to the relevancy of issues in the elderly population infected with Covid-19 in the pandemic era.

When the keyword analysis findings were examined, it was found that the clustering analysis classified geriatric malnutrition subjects into nine distinct clusters. Malnutrition, elderly, nutritional status, aged, mini nutritional assessment, mortality, sarcopenia, depression, nutrition, and older adults were the most frequently used keywords. According to the data, after our search keywords were excluded from the list, the terms studied in recent years were Geriatric Nutritional Risk Index, malnutrition risk, stroke, heart failure, prognosis, GLIM, cancer, and prevention. Protein-energy malnutrition, cachexia, quality of life, geriatric assessment, validity, hospital, aging, anthropometry, sarcopenia, and mini nutritional assessment were the most frequently cited terms.

Only one bibliometric research was discovered while evaluating the literature on geriatric nutrition (12). While it had more publications in analysis, it included meeting abstracts and letters to the editor, and some search criteria were not precisely specific to the issue at hand, so we believe this focused and concise investigation supplements that work. Also, as a critical difference from other similar work, this article's time scope was between 1980 and 2022. Since citation and co-citation analyses could not be done in the PubMed and Scopus databases, they were left out of the analysis. WoS is favored over competing databases because it includes citation analysis and indexes articles from higher-quality publications.

CONCLUSION

Malnutrition in the elderly population is a severe problem globally, notably in aging countries. Early diagnosis, prevention, rehabilitation, and, most importantly, knowledge are vital to reducing malnutrition's effects on the geriatric population. Geriatric malnutrition is one of the current trending research topics and seems more relevant every year in the aging world. We believe this article will lead to more research and publications on this critical topic.

ETHICAL DECLARATIONS

Ethics Committee Approval: Ethics committee approval is not required in this bibliometric study.

Informed Consent: Our research is a retrospective worldwide data analysis. Thus, informed consent is not required.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the manuscript, and they have approved the final version.

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