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Scientific Mapping of Elderly Food Studies: A Bibliometric Approach

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ABSTRACT

As the global population ages, there is a growing emphasis on addressing the dietary needs and overall well-being of older individuals. Bibliometric analysis of existing literature on food innovation for the elderly helps identify research trends and gaps, guiding future exploration to better meet the nutritional needs and preferences of this population. The aim of this research is to examine the literature on food and nutrition for older adults through bibliometric analysis. Data was gathered on April 19th, 2024, from the Scopus database by using the search term "elder* AND food". Articles were restricted to specific subject areas and then analyzed using VOSviewer and descriptive statistics. A total of 746 articles published between 1951 and 2024 were discovered, with a notable rise in publications in the past decade. The United States ranked first in the number of published articles, followed by South Korea and Brazil. Keywords were grouped into 11 clusters, encompassing themes such as diet quality, food security, nutritional status, and elderly care. The analysis underscored the global importance of research on elderly nutrition, underscoring the necessity for international cooperation. Recent developments revealed a concentration on food-based dietary guidelines and the management of food bolus for older individuals. The study also addressed limitations, such as potential biases arising from relying on Scopus and excluding non-English publications.

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Introduction

As the global population continues to age, there is an increasing importance placed on prioritizing the well-being and dietary needs of older individuals. Elderly people are increasingly aware of the importance of nutritious and enjoyable food in attaining happiness and overall well-being (So et al., 2021). The rising life expectancy has led to an increasing demand for addressing the distinct nutritional needs of older adults. A number of older individuals encounter difficulties such as reduced appetite, swallowing issues, and specific health conditions necessitating tailored dietary measures. These factors make it crucial for food innovation to cater to the unique needs of elderly consumers (Lutz, Petzold, & Albala, 2019). In addition to the physiological challenges faced by elderly consumers, there are also social and psychological factors that influence their dietary choices and eating habits(Locher et al., 2009).

Factors such as loneliness, depression, and changes in taste perception can significantly impact the appetite and food preferences of older individuals (Wong, Chau, Fang, & Woo, 2017). Previous study highlights in their study the crucial influence of psychological determinants, such as perceptions of health and motivations for food selection, on the dietary preferences of the elderly population (Lesakova, 2018). These factors have been shown to have a substantial impact on the consumption patterns of nutritious foods among older adults, as evidenced in various research studies. Psychological attributes such as Innovation-Achievement, Elderly-Awareness, and Trend-Convenience play a noteworthy role in shaping the purchase intention of health functional food among elderly consumers (E.-J. Kim, 2016). Consumer ethnocentrism, which is shaped by factors such as age, gender, and income, also give significantly impacts the dietary preferences of elderly individuals, consequently shaping their perceptions towards both local and international food items (Awdziej, Tkaczyk, & Włodarek, 2016).

Sensory factors play a vital role in impacting the dietary selections of older individuals. The decline in sensory abilities associated with aging, particularly changes in taste and smell, may result in unhealthy eating habits such as increasing salt and sugar intake to offset the diminished taste perception. When choosing their meals, the elderly prioritize factors such as health benefits, convenience, sensory appeal, cost, and past culinary experiences (Spence & Youssef, 2021). It is crucial to optimize the sensory, nutritional, social, and emotional dimensions of dining to improve the overall food enjoyment for older adults (Sulmont-Rossé, Symoneaux, Feyen, & Maître, 2018). Meeting the

sensory preferences and expectations of the elderly poses a significant challenge for the food industry (Shahrin, Omar, Daud, & Zakaria, 2019). For individuals facing challenges with chewing, it is advisable to consume soft, moist foods, while enhancing flavors and presenting visually appealing dishes can help mitigate sensory limitations.

Research in the field of food innovation for the aging population has shown a consistent growth in order to tackle these complex challenges (Aguilera & Covacevich, 2023). From customized meal distribution systems to the development of food products suitable for the elderly, there has been a concentrated effort to provide solutions that go beyond basic nutrition. Understanding the intricate interplay between nutritional requirements, sensory experiences, and emotional well-being is fundamental to creating meaningful advancements in this domain (Calligaris et al., 2022).

However, despite the growing interest in food innovation for elderly consumers, there remains a gap in understanding the existing knowledge base and identifying research trends in this area (Alhammadi, Santos-Roldán, & Cabeza-Ramírez, 2021). Bibliometric analysis is a quantitative technique that allows researchers to evaluate and analyze scientific publications in a specific subject area. In this bibliometric analysis, we aim to investigate the present state of food innovation targeted towards the elderly demographic through an examination of trends, primary research domains, and the noteworthy publications that hold significant influence within this particular area. By understanding the existing body of literature, we can identify gaps in research and potential areas for future exploration to better address the dietary needs and preferences of the elderly population.

Method

Collecting and Refining Database

Methodological steps of our research consisted of collecting and screening data, exporting data, and analyzing by descriptive statistics and Vosviewer. Data collection for this research was performed on April 19th, 2024, from the Scopus electronic databases (https://www.scopus.com/). Data were collected using the query of "elder* AND food", for comprehensive results. Database were collected from articles which is limited to subject area of "Medicine", "Nursing", "Agricultural and Biological Sciences", "Social Sciences", "Psychology", "Pharmacology, Toxicology and Pharmaceutics", and "Multidisciplinary". There is no language restriction applied. Database containing bibliographic information, publication and citation information, abstracts as well as the address of article web page, were used to construct and visualize directory network information. Database were also saved as .csv files and .ris files to be analyzed using Mendeley Desktop v.1.19.8 © 2008-2020 and Microsoft® Excel 2019.

Bibliometric Analysis

Database were imported into the VOSviewer v.1.6.18 (Center for Research in Science and Technology (CWTS), Leiden University, Leiden, Netherlands) to create visualization map of key terms drawn from a scientific literature. To enhance the visualization quality, a threshold of 4 was established for the minimum frequency of term occurrences. Subsequently, the relevance score for each term was computed by VOSviewer. Adhering to the default setting of VOSviewer, a maximum of 60% of the most relevant terms were chosen for further analysis. Approximately 60% of the most relevant terms or keywords were subsequently represented in network, overlay, and density visualizations. Strengths of the links identified in the maps were utilized to depict various interconnections among the articles, countries, and institutions of their provenance, as well as co-citations and authors. A greater thickness of the connecting line and a higher numerical value assigned to the link indicated a more robust correlation in the assessment aspect.

Results

Number of Publications by Year

There were 746 related articles has been found since 1951. As can be seen in Figure 1, the annual number of related articles has grown substantially. Moreover, a total of 314 articles were published over the last decade since 2014.

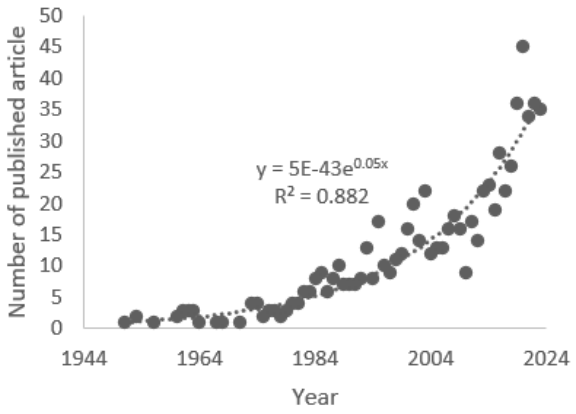

Figure 1. Annual number of related articles (1951-2024)

Active Countries, Authors, and Journals

Authors from 60 different countries participated in publishing the articles about elderly food. The top 10 active countries participated is shown in Figure 2. The United States ranked first (156) regarding the number of published articles, followed by South Korea, Brazil, Japan, France, United Kingdom, Netherlands, Spain, Italy, and China. The overall geographic distribution of the publications is shown by Figure 3.

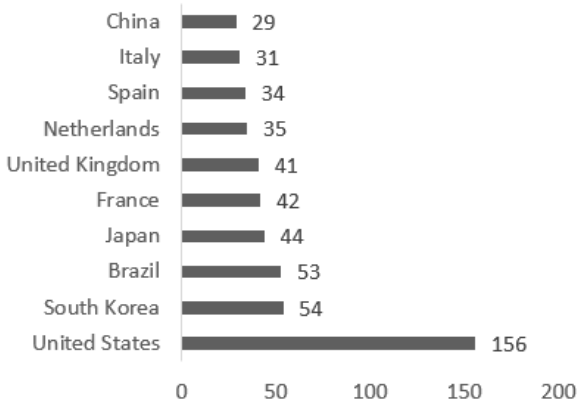

Figure 2. Geographic distribution of related articles based on the country affiliation of author

Keywords Mapping

Network visualization, overlay visualization; and density visualization were provided by VOSviewer based on keywords. Most frequent keywords (71 terms) were visualized by Figure 4, 5 and 6. The visualization showed 11 clusters (Table 1).

Table 1. Cluster of keywords

Cluster	Terms/Keywords
1 (red)	*diet, diet quality, energy intake, exercise, food preferences, food security, health status, micronutrients*
2 (green)	*china, dementia, food, food intake, food supplements, gender, older people, satisfaction with food-related*
3 (blue)	*aging, antioxidant, dysphagia, food bolus, older status, oral health, taste, texture*
4 (yellow)	*ageing, dietary habits, food consumption, nutrition, the elderly, vitamins, women*
5 (lavender)	*activities of daily living, anthropometry, appetite, body composition, nutrition assessment, physical activity, undernutrition*
6 (sky blue)	*elderly care, elderly people, food choice, functional food, nutritional status, protein, quality of life*
7 (orange)	*aged, elderly nutrition, food based dietary guidelines, food safety, malnutrition, south Africa*
8 (purple violet)	*body mass index, elderly, nutrients, obesity, sarcopenia*
9 (lilac)	*dietary intake, elderly women, food habits, nutrient intake, nutrient intakes*
10 (pink)	*ffq, food frequency questionnaire, reproducibility, validity*
11 (light green)	*depression, food insecurity, fruits, vegetables*

Discussion

Growth of Publications

Current study is aimed to assess and analyze published article on elderly food. We would like to analyze the growth, trends, and domains of published article related to elderly food. The annual number of articles shows that the number of studies related to elderly food tends to increase (Figure 1). Current study found an exponential curve on annual number of articles described by the model of $y = 5E\text{-}43e^{0.05x}$. This model indicates that the number of publications increases at an exponential rate every year. The model is characterized by a very small initial value that grows exponentially at a rate of 5% per unit increase in year. The R^2 of 0.882 means that approximately 88.2% of the variance in the dependent variable (number of publications) can be explained by the independent variable (year) using this exponential model. This indicates a strong correlation between variable. The model is reliable for predicting the behavior of the number of publications based on year. If this trend continues, it is estimated that publications related to food for the elderly will increase.

Source of Publications

We found that the United States leads in the number of published articles on elderly food, with 156 contributions. South Korea and Brazil followed closely with 54 and 53 articles, respectively, indicating active research interest in the dietary needs of the elderly. Japan, France, and the United Kingdom were also significant contributors, each with over 40 articles focusing on geriatric nutrition and health, showcasing their well-established research infrastructures. Netherlands, Spain, and Italy showed strong involvement in elderly food research, with over 30 articles each, signifying a global awareness of nutritional challenges among aging populations. Canada, Sweden, and Australia are also prominent in the dataset, demonstrating their dedication to understanding and tackling dietary challenges among their aging populations. China has 29 published articles related to food for elder. Its large population and aging demographic emphasize the importance of research to address the nutritional needs of its elderly citizens. China, having the largest elderly population globally, is currently undergoing a unique aging phenomenon. The majority of elderly individuals in China, particularly those in rural areas, rely on savings and assistance from their children for financial support, leading to considerable uncertainty regarding their future spending (Zhang, Luo, & Robinson, 2018).

In conclusion, the distribution of published articles worldwide underscores the global significance of elderly food research in promoting health among older adults. This emphasizes the necessity of international collaboration to develop effective way

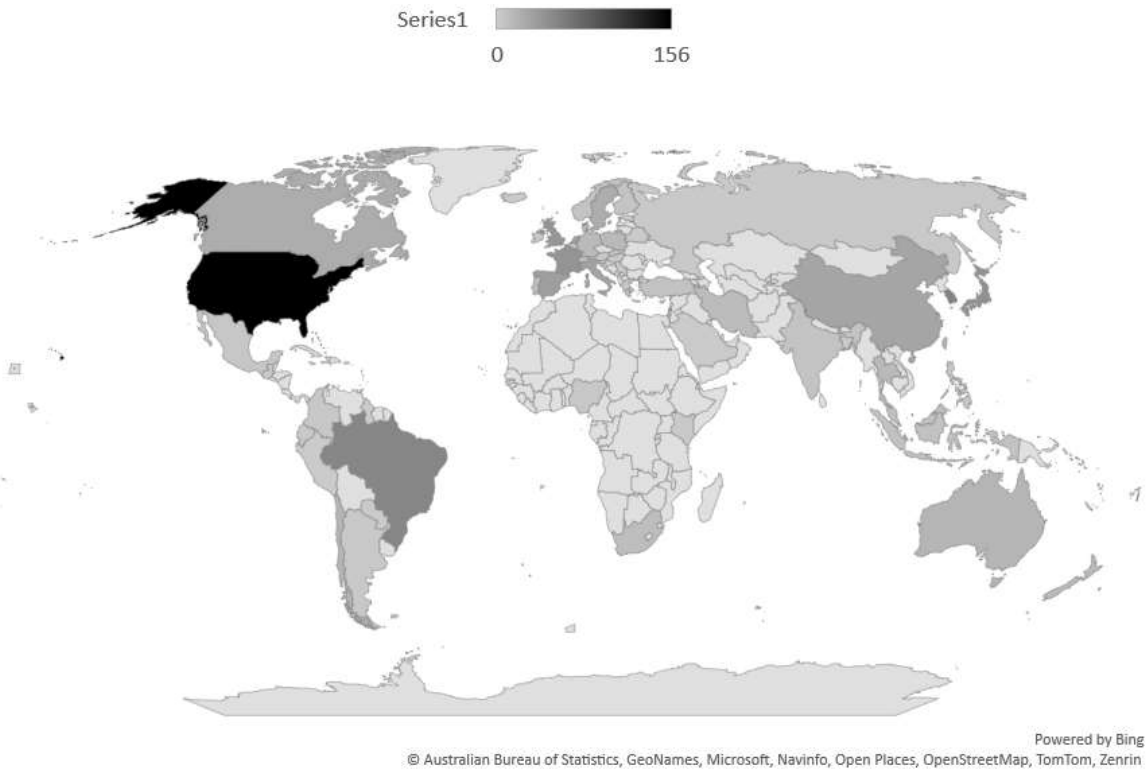

Figure 3. Overall geographic distribution of related publications

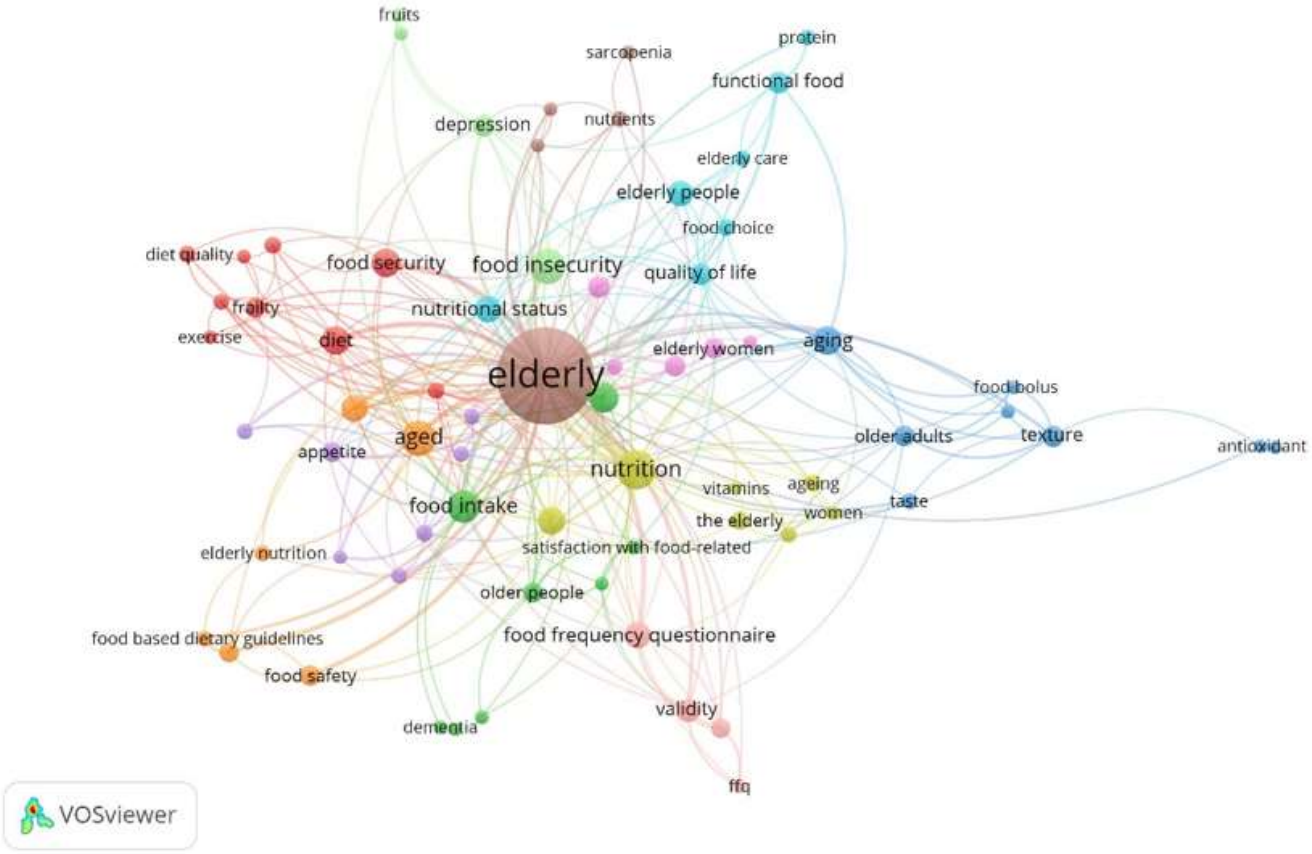

Figure 4. Network visualization map of keywords in the related papers

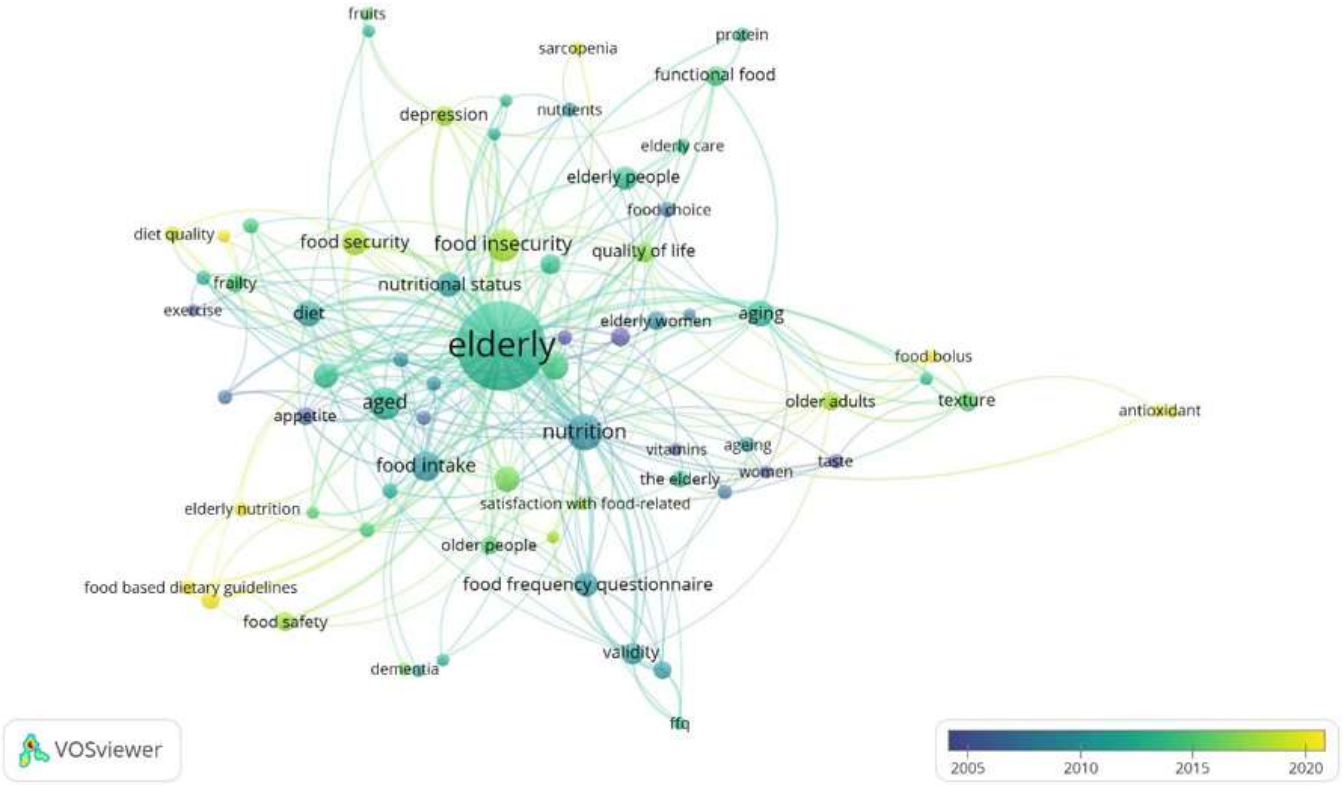

Figure 5. Overlay visualization map of keywords in the related papers

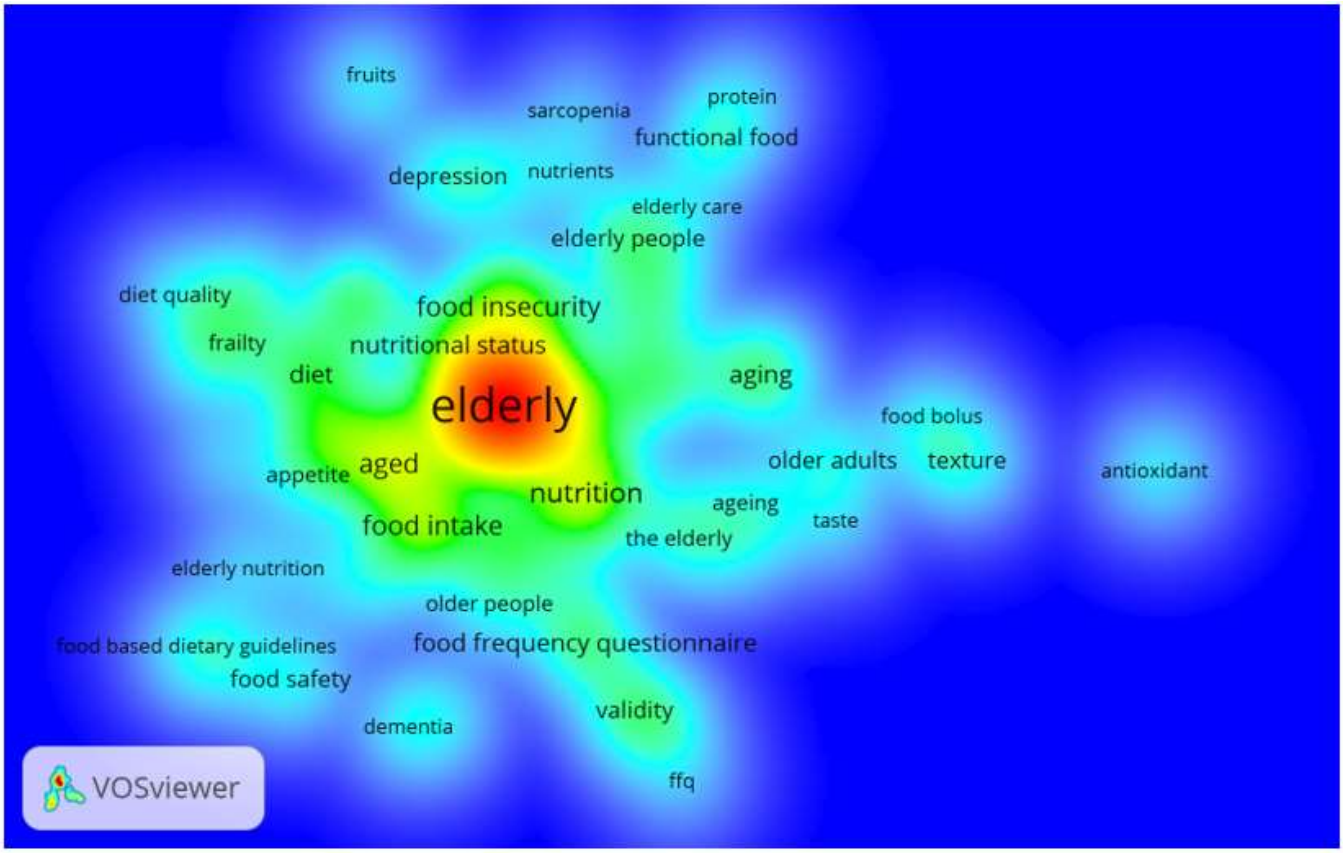

Figure 6. Density visualization map of keywords in the related papers

for addressing the nutritional needs of aging populations globally. Other countries that publish articles concerning elderly nutrition with less than 10 entries are also included South Africa, Denmark, Switzerland, Malaysia, Indonesia, Turkey, India, Norway, Finland, Belgium, Mexico, Colombia, Greece, Hong Kong, Israel, Nigeria, Slovakia, Argentina, Austria, Ecuador, Hungary, Ireland, Kenya, Philippines, Russian Federation, Slovenia, Bahrain, Bangladesh, Belarus, Cyprus, Estonia, Guatemala, Guyana, Iceland, Mauritius, Paraguay, Peru, Saudi Arabia, and Serbia.

We also found 11 active journals publishing articles related to elderly food (Table 2). The subject area of those active journals was medicine, nursing, and agricultural and biological science.

Table 2. Active journal in the field of elderly food

Source	N	Subject Area
Journal of Nutrition for The Elderly	32	Medicine, Nursing
Journal of Nutrition Health and Aging	27	Medicine, Nursing
Journal of The American Dietetic Association	25	Agricultural and Biological Science, Medicine, Nursing
Nutrients	19	Agricultural and Biological Science, Nursing
British Journal of Nutrition	18	Medicine, Nursing
Food Quality and Preference	15	Agricultural and Biological Science, Nursing
Asia Pacific Journal of Clinical Nutrition	12	Medicine, Nursing
Appetite	11	Nursing, Psychology
European Journal of Clinical Nutrition	10	Medicine, Nursing
Journal of Human Nutrition and Dietetics	10	Medicine, Nursing
Journal of The Korean Society of Food Science and Nutrition	10	Agricultural and Biological Science, Nursing

Mapping of Publications

VOSviewer classified the keywords into 11 clusters (Table 1). These clusters provide a comprehensive view of the various factors affecting food and nutrition for elderly. Cluster 1 focuses on the overarching themes of diet and food-related health among the elderly, emphasizing elements like diet quality, energy intake, exercise, food preferences, and health status. The interaction of these factors is crucial in determining the health outcomes of older adults, highlighting the importance of diet and physical activity in preventing chronic diseases and maintaining well-being.

Cluster 2 explores social and demographic factors that impact food-related health in the elderly, discussing gender differences, satisfaction with food, and cultural influences, particularly in China. Cognitive decline, dementia, and food supplements are also addressed, indicating a potential area for addressing dietary deficiencies common among the elderly population.

The focus of cluster 3 is on sensory and physical changes associated with aging that affect food consumption, addressing challenges such as dysphagia, oral health, taste, and texture. Modifying food textures and enhancing flavors are suggested to help older adults overcome these difficulties and maintain adequate food intake. Cluster 4 focuses on broader issues around aging, dietary habits, and nutrition, with a focus on maintaining proper nutrient levels and healthy aging practices. Gender-specific considerations for elderly women and the importance of vitamins in the diet are highlighted to emphasize the unique nutritional needs of older individuals.

Cluster 5 examines physical health indicators and their correlation with food and nutrition, highlighting concepts like body composition, appetite, undernutrition, and physical activity. The emphasis on maintaining an active lifestyle and assessing body composition underscores the significance of these factors in elderly nutrition. Cluster 6 discusses elderly care topics such as functional food, nutritional status, protein intake, and quality of life, with a particular focus on addressing muscle loss and sarcopenia. Quality of life is emphasized, suggesting that dietary choices should contribute positively to overall well-being for the elderly population.

Cluster 7 centers on food safety and malnutrition issues among the elderly, advocating for the development of food-based dietary guidelines tailored to specific needs. The regional perspective from South Africa indicates a broader view on elderly nutrition, applicable to other developing regions facing similar challenges. Cluster 8 is focused on obesity and related health conditions like sarcopenia in the elderly, using body mass index (BMI) and nutrient intake as key indicators of nutritional health. Managing obesity and sarcopenia is crucial for reducing the risk of chronic diseases and enhancing mobility and function in older adults.

Cluster 9 discusses food habits and nutrient intake, with a specific mention of elderly women. Nutrient intake plays a critical role in supporting the health and longevity of the elderly, and understanding food habits can guide effective interventions. Cluster 10 revolves around methodological approaches to studying elderly food and nutrition, with an emphasis on food frequency questionnaires (FFQs), reproducibility, and validity. These methodologies are essential for gathering accurate data and ensuring that studies in this field yield reliable results. The final cluster (cluster 11) addresses

psychological and social factors, including depression, food insecurity, and fruit consumption. Depression is a significant concern among the elderly, and food insecurity can exacerbate this. Encouraging fruit consumption and addressing food insecurity are important strategies for improving both mental and physical health among the elderly.

Trends and Recent Study

The overlay visualization in Figure 5 is utilized for displaying development and trends over time, showcasing the state-of-the-art of related research. The color of the overlay map conveys distinct information compared to the network map. Changes in node color reflected differences in the publication year, where the spectrum ranges from purple denoting past terms to yellow signifying recent terms. Based on the result, recent study on elderly food covered the terms of food based dietary guideline, food bolus, elderly nutrition, health status. The development and implementation of food-based dietary guidelines tailored for the aging population must be a top priority in elderly food research. These guidelines play a crucial role in meeting the unique nutritional needs of older individuals, who commonly encounter challenges like reduced appetite and changes in metabolic rates (Napier, Grobbelaar, & Oldewage-Theron, 2021). A key aspect of elderly nutrition involves creating and managing the food bolus, which grows increasingly important due to the higher prevalence of dysphagia and other swallowing issues in seniors (Assad-Bustillos, Tournier, Septier, Della Valle, & Feron, 2019; Ben Tobin et al., 2020; Lorieau et al., 2021). Well-designed food boluses that are easy to chew and swallow can significantly boost nutrient intake and prevent malnutrition (Chao et al., 2023; Lorieau et al., 2018; Mitrović, Karan, Karan, & Vucinić, 2014). Moreover, when focusing on elderly nutrition, it is vital to take into account the overall health status of this demographic, which includes the presence of chronic conditions and the general decline in physiological functions (D. Kim & Lim, 2020). By incorporating comprehensive dietary guidelines that address the specific requirements of older adults, and by ensuring that the food bolus is appropriate for their eating abilities, we can enhance the health status and overall quality of life for seniors. This comprehensive approach is crucial for promoting optimal nutrition and health outcomes among the elderly

The density visualization (Figure 6) provided a rapid overview of the main areas in the bibliometric network. No lines connected the keywords, but each keyword was distinguished by varying color intensities. The node's color in the visualization was decided based on the density of terms at that location, which were then translated into a color value. A node's color intensity increased with the term density. Matching the node's color value to the color values and blending between the two determined the final color of the node.

The term *elderly* appeared as the highest density term due to highest occurrence score in database, followed by *nutritional status, nutrition, food intake, aged, appetite*, and *food insecurity*. It means that research related to elderly food mostly discussed the theme of nutritional status, nutrition, food intake, aged, appetite, and food insecurity. However, several terms or themes, such as *quality of life, satisfaction with food-related, oral health*, were hard to be seen on density visualization map due to the lowest occurrence score. It means that related research about elderly food rarely discussed about the themes and their novelty was quite high. Older adults may encounter challenges with chewing and swallowing food, experience discomfort when chewing or biting, and suffer from nutritional deficiencies that impact their quality of life (Nakagawa & Matsuo, 2019).

Limitation of Study

Scopus provides the most extensive overview of global research output across various fields such as science, technology, medicine, social science, and arts and humanities. However, it is important to note that there is a significant amount of information from various sources and databases that are not covered here. Utilizing Scopus for literature search can introduce a bias towards countries with a high number of journals listed in Scopus. Scopus favors academic journals that publish documents in English, resulting in the exclusion of documents published in languages other than English. Similar to other bibliometric studies, the current research did not incorporate grey literature. The search methodology employed in this study may have influenced the presence of false outcomes.

Conclusion

The analysis of literature on elderly nutrition through bibliometrics reveals a significant increase in research in recent decades, with notable contributions from various countries. Leading contributors include the United States, South Korea, and Brazil, demonstrating a strong global interest in geriatric nutrition. Keyword mapping has identified key research clusters, emphasizing important themes such as diet quality, food security, and elderly care. Recent studies have particularly focused on developing dietary guidelines and managing dysphagia through food bolus techniques. These results underscore the necessity for continued research and international cooperation to address the unique nutritional requirements of the aging population. While the study's scope is comprehensive, it is important to acknowledge limitations such as potential bias from using the Scopus database and the exclusion of non-English literature when interpreting the findings. Future research efforts should strive to incorporate a wider range of sources to overcome these limitations and offer a more comprehensive view of global research

Author Contribution and Competing Interest

NEP as first author contributed in designing the analysis, performing the analysis, and drafting the manuscript. MIF as second author contributed in collecting the database and interpreting the

information. We declare that there is no conflict of interest.

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