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Research Article

CULINARY MEDICINE: A NEW ERA OF HEALTH THROUGH THE KITCHEN**

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Abstract

Culinary medicine is a recently established field of study that employs an innovative approach to food and cooking with the objective of promoting healthy ageing, mitigating the effects of chronic diseases, and addressing lifestyle diseases. Over the past decade, the discipline of culinary medicine has been incorporated into several different academic fields, including medicine, nutrition and dietetics, nursing, physician training, clinical practice, and gastronomy and culinary arts. The objective of this study is to examine the researchers published in Scopus in terms of descriptive, performance and research themes through the implementation of bibliometric analysis. The findings indicated that the field of culinary medicine originated in the USA, with the majority of studies conducted by US-based institutions. In the preceding five years, there has been a notable increase in research activity in this area, with a significant rise in the number of studies published in comparison to previous years.

Keywords: Culinary Medicine, Bibliometric Analysis, Gastronomy, Culinary Skills, Nutrition

Introduction

In terms of maintaining a healthy lifestyle, diet is arguably one of the most crucial elements. It is not only essential to obtain the necessary nutrients for survival; it is also crucial to adopt a healthy lifestyle in order to age gracefully, regardless of whether one is cooking at home or dining out. In order to ensure the health and well-being of all individuals at all stages of life, the Sustainable Development Goals (SDGs) also address the detrimental effects currently being wrought upon the environment by the prevailing food systems and the concerns raised about their sustainability (Guégan et al., 2018). In light of the considerable divergence of opinions regarding the concepts of sustainable nutrition and healthy nutrition, countries have requested that the United Nations (UN) Food and Agriculture Organization (FAO) and the World Health Organization (WHO) prepare a guide that can provide guidance on the principles and accessibility of sustainable and healthy nutrition (WHO, 2019). These guiding principles are informed by international nutritional recommendations and adopt a holistic approach to diets, ensuring that the environmental cost of food production and consumption is compatible with local social, cultural and economic contexts. In light of these developments, a novel interdisciplinary field, culinary medicine, has also emerged, which draws upon the principles of both gastronomy and medicine. This field of study is an interdisciplinary one, encompassing the scientific study of food and cooking in the context of medicine and nutrition.

The field of culinary medicine has emerged over the past decade as a means of promoting health and wellbeing through the integration of evidence-based nutritional knowledge with culinary skills and expertise drawn from a range of healthcare professions, particularly among those working as dietary consultants (Maker-Clark et al., 2023). It is not only a novel approach to nutritional education but also the incorporation of culinary principles into contemporary medical disease prevention and treatment methodologies (Sicker et al., 2020). There has been a notable increase in interest among medical schools in incorporating culinary medicine into their curricula to equip students with practical nutrition and culinary skills that they can apply in nutrition-specific

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care in clinical settings and for the management of various diseases (Tan et al., 2022; Donovan et al., 2023; Humerick et al., 2024). Additionally, there is evidence to support the inclusion of culinary arts education for high school students (Craven et al., 2023) and home cooking education (Ai et al., 2024; Allen-Winters et al., 2019; Johnston et al., 2021).

In the last decade, there has been an emergence of studies related to the field of culinary medicine. The present study was designed with the objective of identifying research in the field of culinary medicine and investigating its linkage to the gastronomy field. The aim of this study was to provide a descriptive account of international research in the field of culinary medicine, including the year of publication, the country of affiliation, the journal in which the research was published, and the most cited studies. Furthermore, the study sought to categorise the themes that emerged from the research. In alignment with the aforementioned objective, research questions were formulated and addressed through a bibliometric analysis. The following research questions were identified:

- What is the distribution of studies on culinary medicine according to the year in which they were published?
- In which country is culinary medicine research most prevalent?
- What is the distribution of studies on culinary medicine according to the journal in which they are published?
- In which category are studies related to culinary medicine evaluated according to the subject under consideration?

Furthermore, this study can contribute to the identification of the emerging field of culinary medicine, the challenges it faces, the gaps in knowledge that require further investigation and potential avenues for future research, particularly in the context of culinary medicine education within bachelor's degrees in gastronomy and culinary arts.

Literature Review

Bibliometric analysis is a quantitative research technique that can be used to evaluate large amounts of published research in an objective manner. This may include the number of citations and publications, occurrences of keywords and topics, leading articles, authors, affiliations and other relevant data (Khan et al., 2021). The objective interpretation of performance analysis results and the subjective evaluation of thematic analysis results are conducted through the utilisation of informed techniques and procedures. Consequently, bibliometric analysis represents a valuable instrument for mapping the cumulative scientific knowledge and evolutionary aspects of well-established fields, whereby a logical information structure is constructed from the extensive volumes of unstructured data (Donthu et al., 2021a). Furthermore, bibliometric analysis enables scholars to gain a comprehensive overview, identify knowledge gaps, derive novel ideas for further investigation and situate intended contributions within the broader context of the field (Donthu et al., 2021b).

In the context of the expanding corpus of literature on the subject of culinary medicine, undertaking a bibliometric analysis is imperative to attain a more profound comprehension of the patterns of publication and citation within this domain. A review of the extant literature revealed a solitary bibliometric analysis of culinary medicine, which spans the period between 1992 and 2022 (Mallya, Thirugnanasambantham and Shettigar, 2023). This study encompassed a total of 47 documents sourced from the Scopus peer-reviewed database. Despite the potential of this article, it has been observed that there has been an increase in the field of culinary medicine in recent years, evidenced by new areas such as gastronomy other than the medicine and nutrition disciplines. Mutlu and Doğan (2021) determined the gastronomy to the medicine and health field along with the conceptual framework for the culinary medicine chef definition by implementing interview to the focus group including the gastronomy chefs, nutritional dietitians and using qualitative analysis.

Culinary medicine is not synonymous with gourmet cooking. Rather, it is a field that focuses on the relationship between sustenance and health, with the objective of preventing chronic diseases through the enhancement of culinary skills (Mauriello and Artz, 2019). Consequently, a recent development in educational programming for health professions has been the integration of culinary arts and gastronomy with the scientific principles of medicine (Hauser, 2019; Polak et al., 2016). The culinary medicine concept has been explored through the adaptation of the curriculum for either medicine or physicians' education for different purposes. Nascimento et al. (2024) advanced the notion of incorporating culinary medicine education into the medical curriculum as an elective course. They posited that this integration would not only facilitate the development

of students' practical skills but also promote a shift in their daily habits toward healthier lifestyle practices. Vasques et al. (2024) explored the potential of culinary medicine to support the promotion of healthy eating and the prevention of malnutrition. They proposed a framework comprising four dimensions: culinary skills, communication, fundamental nutrition principles, and physicians' self-care. Additionally, the study underscored the significance of medical nutrition training in enhancing physicians' skills, particularly in the area of counselling patients on promoting healthier home cooking practices to prevent malnutrition. Newman et al. (2023) conducted a scoping review of the extant literature on culinary medicine programs, indicating that such programs for medical students incorporated hands-on learning in the kitchen or analogous adaptable food preparation settings for the practical application.

Method

The bibliometric data for this study was accessed in September 2024 from the Scopus database, which is widely recognised as a leading search engine for bibliometric studies (Yeung, Mocan, and Atanasov, 2018; Wiyono et al., 2024). A search of the Scopus search engine was conducted using the term "culinary medicine" in conjunction with a series of keywords to identify published studies on the subject. The string was employed to identify published materials that contain the term "culinary medicine" in their keywords section. A total of 143 published studies were identified through the search process, comprising articles, reviews, book chapters, notes, and short surveys on 30th September 2024. A total of 94 peer-reviewed articles were selected for further analysis and visualisation in VOSviewer (v 1.6.19), as detailed in Table 1. The book chapters, notes and short reports were excluded from the data set.

Table 1. The list of the articles selected for further analysis

Author	Affiliation country	Title	Published Journal
Albin et al. (2024)	USA	There and Back Again: A Forty-Year Perspective on Physician Nutrition Education	Advances in Nutrition
Ai et al. (2024)	USA	Development of a Culinary Medicine Toolkit to Improve Implementation of Virtual Cooking Classes for Low-Income Adults with Type 2 Diabetes	Healthcare (Switzerland)
Albin et al. (2024)	USA	From Clinic to Kitchen to Electronic Health Record: The Background and Process of Building a Culinary Medicine eConsult Service	Journal of Multidisciplinary Healthcare
Glickman et al. (2024)	USA	Exploring the effectiveness of virtual and in-person instruction in culinary medicine: a survey-based study	BMC Medical Education
Loy, Prisco and Parikh (2024)	USA	Implementation of Virtual Integrative Oncology Shared Medical Appointment Series (VIOSMAS) Within Mixed Diagnosis Population	Integrative Cancer Therapies
Bergquist et al. (2024)	USA	Effect of the Emory Healthy Kitchen Collaborative on Employee Health Habits and Body Weight: A 12-Month Workplace Wellness Trial	Nutrients
Croxford et al. (2024)	USA	Culinary Medicine or Culinary Nutrition? Defining Terms for Use in Education and Practice	Nutrients
Dodin, Bégin and Lucas (2024)	Canada	Improvement in Nutritional Knowledge Confidence and Food-Agency: Outcomes of the First French-Speaking Culinary Medicine Courses Among Medical Students	American Journal of Lifestyle Medicine
Hildebrand et al. (2024)	USA	Culinary Medicine Experiences for Medical Students and Residents in the U.S. and Canada: A Scoping Review	Teaching and Learning in Medicine
Humerick et al. (2024)	USA	Four-year longitudinal culinary and lifestyle medicine track for undergraduate medical students: development and implementation	Medical Education Online
Johnston et al. (2024)	USA	Integrating nutrition and culinary medicine into preclinical medical training	BMC Medical Education
Kirby et al. (2024)	USA	Assessing nutrition literacy and nutrition counseling proficiency following an interdisciplinary culinary medicine elective	Journal of Osteopathic Medicine
Krenek et al. (2024)	USA	Behavioral Frameworks and Translational Applications of Culinary Medicine and Culinary Nutrition	Journal of Nutrition Education and Behavior

Lindsay et al. (2024)	USA	Development of a Culinary Medicine Curriculum to Support Nutrition Knowledge for Gastroenterology Fellows and Faculty	Nutrients
Macias-Navarro et al. (2024)	USA	A virtual culinary medicine intervention for ethnically diverse individuals with type 2 diabetes: development of the Nourishing the Community through Culinary Medicine	Frontiers in Nutrition
Salas-Groves et al. (2024)	USA	The Effect of Web-Based Culinary Medicine to Enhance Protein Intake on Muscle Quality in Older Adults: Randomized Controlled Trial	JMIR Formative Research
Staffier et al. (2024)	USA	Evaluation of the reach and utilization of the American College of Lifestyle Medicine's Culinary Medicine Curriculum	Frontiers in Nutrition
Temelkova et al. (2024)	USA	Nourishing Conversations: Using Motivational Interviewing in a Community Teaching Kitchen to Promote Healthy Eating via a Food as Medicine Intervention	Nutrients
Albin, Siler and Kitzman (2023)	USA	Culinary Medicine eConsults Pair Nutrition and Medicine: A Feasibility Pilot	Nutrients
Asher et al. (2023)	Australia	Impact and evaluation of an online culinary nutrition course for health, education and industry professionals to promote vegetable knowledge and consumption	Journal of Human Nutrition and Dietetics
Asher et al. (2023)	Australia, Netherlands	Facilitators and barriers to providing culinary nutrition, culinary medicine and behaviour change support: An online cross-sectional survey of Australian health and education professionals	Journal of Human Nutrition and Dietetics
Brennan et al. (2023)	USA	Impact of Culinary Medicine Course on Confidence and Competence in Diet and Lifestyle Counseling, Interprofessional Communication, and Health Behaviors and Advocacy	Nutrients
Böttcher et al. (2023)	Germany	Comparison of Effectiveness regarding a Culinary Medicine Elective for Medical Students in Germany Delivered Virtually versus In-Person	Nutrients
Charles et al. (2023)	USA	"Zoom"ing to the Kitchen: A Novel Approach to Virtual Nutrition Education for Medical Trainees	Nutrients
Kalra et al. (2023)	India	Culinary Counselling in Chronic Care: The Pentad of Cs and Ps	Journal of the Pakistan Medical Association
Ring, Maker-Clark and Sarazen (2023)	USA	Cooking up Change: DEIB Principles as Key Ingredients in Nutrition and Culinary Medicine Education	Nutrients
Sommer et al. (2023)	USA	Evaluation of dietary habits and cooking confidence using virtual teaching kitchens for perimenopausal women	BMC Public Health
Badaracco et al. (2023)	USA	Characteristics of Current Teaching Kitchens: Findings from Recent Surveys of the Teaching Kitchen Collaborative	Nutrients
Catalán et al. (2023)	Spain	Influence of Nutrition Training, Eating Habits, and Culinary Skills of Health Care Professionals and Its Impact in the Promotion of Healthy Eating Habits	Topics in Clinical Nutrition
Craven et al. (2023)	USA	Creating Teams of Family Medicine Residents and High School Culinary Students Reduces Some Barriers to Implementing a Culinary Medicine Hands-On Workshop	Medical Science Educator
Donovan et al. (2023)	USA	Eat to Treat: The Methods and Assessments of a Culinary Medicine Seminar for Future Physicians and Practicing Clinicians	Nutrients
Gayoso et al. (2023)	Spain	An intensive culinary intervention programme to empower type 2 diabetic patients in cooking skills: The SUKALMENA pilot study	International Journal of Gastronomy and Food Science
Haggard-Duff et al. (2023)	USA	Interprofessional Students' Perspectives on Culinary Medicine Training: Intentions from Plate to Practice	Medical Science Educator

Kalra, Prisco and Parikh (2023)	Australia	Medical Gastronomy and Glucofriendly Gastronomy: Tools for Chronic Disease and Diabetes Care	Journal of the Pakistan Medical Association
Maker-Clark et al. (2023)	USA	Empowering Future Physicians and Communities on Chicago's South Side through a 3-Arm Culinary Medicine Program	Nutrients
McGuire et al. (2023)	USA	Redesigning Recruitment and Engagement Strategies for Virtual Culinary Medicine and Medical Nutrition Interventions in a Randomized Trial of Patients with Uncontrolled Type 2 Diabetes	Nutrients
Sijangga et al. (2023)	USA	Culturally-tailored cookbook for promoting positive dietary change among hypertensive Filipino Americans: a pilot study	Frontiers in Nutrition
Thircuir, Chen and Madsen (2023)	Lebanon, USA	Addressing the Gap of Nutrition in Medical Education: Experiences and Expectations of Medical Students and Residents in France and the United States	Nutrients
Doxey et al. (2023)	USA	Building Flavor and Confidence in the Kitchen: A Pilot Virtual Cooking Class on Healthy Snacking	American Journal of Lifestyle Medicine
Mallya and Shettigar (2023)	India	Uncovering culinary medicine research themes: Current status and future direction	F1000Research
Raber et al. (2023)	USA	The Bite of HOPE Small Food Business Development Program: a clinic-based culinary medicine program targeting local business owners	Translational Behavioral Medicine
Raber et al. (2023)	USA	Modern Home Cooking Practices, the Role of New Media, and Implications for Culinary Medicine: A Qualitative Study Among Mothers with Low Income	American Journal of Lifestyle Medicine
Wetherill et al. (2023)	USA	Food Is Medicine for Individuals Affected by Homelessness: Findings from a Participatory Soup Kitchen Menu Redesign	Nutrients
Stauber et al. (2022)	USA	Multisite Medical Student–Led Community Culinary Medicine Classes Improve Patients' Diets: Machine Learning–Augmented Propensity Score–Adjusted Fixed Effects Cohort Analysis of 1381 Subjects	American Journal of Lifestyle Medicine
Tan et al. (2022)	New Zealand	Exploring culinary medicine as a promising method of nutritional education in medical school: a scoping review	BMC Medical Education
D'Adamo et al. (2022)	USA	Culinary Medicine Training in Core Medical School Curriculum Improved Medical Student Nutrition Knowledge and Confidence in Providing Nutrition Counselling	American Journal of Lifestyle Medicine
Poulton and Antono (2022)	USA	A Taste of Virtual Culinary Medicine and Lifestyle Medicine—An Online Course for Medical Students	American Journal of Lifestyle Medicine
McWhorter et al. (2022a)	USA	Training of Registered Dietitian Nutritionists to Improve Culinary Skills and Food Literacy	Journal of Nutrition Education and Behavior
McWhorter et al. (2022b)	USA	Barriers and Facilitators of Implementing a Clinic-Integrated Food Prescription Plus Culinary Medicine Program in a Low-Income Food Insecure Population: A Qualitative Study	Journal of the Academy of Nutrition and Dietetics
Hynicka et al. (2022)	USA	Interprofessional Culinary Medicine Training Enhanced Nutrition Knowledge, Nutrition Counseling Confidence, and Interprofessional Experience	Journal of Integrative and Complementary Medicine
Goni et al. (2022)	Spain, USA	Development and Validation of a New Home Cooking Frequency Questionnaire: A Pilot Study	Nutrients
Yousef et al. (2022)	USA	Bringing the "Joy of Healthy Eating" to Advanced Medical Students: Utilizing a Remote Learning Platform to Teach Culinary Medicine: Findings from the First Online Course Based on the ACLM's Whole-Food Plant-Based Culinary Medicine Curriculum	American Journal of Lifestyle Medicine

Bonnet et al. (2022)	USA	Cost Analysis of Developing, Implementing, and Evaluating a Multi-Disciplinary Teaching Kitchen	American Journal of Lifestyle Medicine
Bredhauer et al. (2022)	Australia	Hungry for more: Australian medical students' competence, attitudes and preferences towards nutrition education	BMC Medical Education
Wattick, Sauborn and Olfert (2022)	USA	Impact of a Brief Culinary Medicine Elective on Medical Students' Nutrition Knowledge, Self-efficacy, and Attitudes	Medical Science Educator
Sharma et al. (2021)	USA	Impact of a virtual culinary medicine curriculum on biometric outcomes, dietary habits, and related psychosocial factors among patients with diabetes participating in a food prescription program	Nutrients
Magallanes et al. (2021)	USA	Nutrition from the kitchen: culinary medicine impacts students' counseling confidence	BMC Medical Education
Silver et al. (2021)	Israel, USA	The impact of a culinary coaching telemedicine program on home cooking and emotional well-being during the covid-19 pandemic	Nutrients
Mutlu and Doğan (2021)	Turkey	A new trend in gastronomy: Culinary medicine chef	International Journal of Gastronomy and Food Science
Johnston et al. (2021)	USA	Culinary Medicine for Family Medicine Residents	Medical Science Educator
Marshall and Albin (2021)	USA	Food as Medicine: A Pilot Nutrition and Cooking Curriculum for Children of Participants in a Community-Based Culinary Medicine Class	Maternal and Child Health Journal
Leggett et al. (2021)	USA	A Suggested Strategy to Integrate an Elective on Clinical Nutrition with Culinary Medicine	Medical Science Educator
Naidoo (2021)	USA	Eat to Beat Stress	American Journal of Lifestyle Medicine
Doxey, Krug and Tivis (2021)	USA	The Lunch Conference Diet: Fostering Resident Engagement in Culinary Medicine Through a Curriculum Centered on Changes to Provided Conference Food	American Journal of Lifestyle Medicine
Shamsi et al. (2021)	India	Biological Characterization and Preliminary Crystallization: A Step Towards the Use of Novel Allium sativum Protease Inhibitor as a Potential Therapeutic Drug	Current Enzyme Inhibition
Eisenberg and Imamura (2020)	USA	Teaching Kitchens in the Learning and Work Environments: The Future Is Now	Global Advances In Health and Medicine
Rothman et al. (2020)	USA	A Culinary Medicine Elective for Clinically Experienced Medical Students: A Pilot Study	Journal of Alternative and Complementary Medicine
Hauser et al. (2020)	USA	The First, Comprehensive, Open-Source Culinary Medicine Curriculum for Health Professional Training Programs: A Global Reach	American Journal of Lifestyle Medicine
Sicker et al. (2020)	USA	Implementing Culinary Medicine Training: Collaboratively Learning the Way Forward	Journal of Nutrition Education and Behavior
Parks and Polak (2020)	Israel, USA	Culinary Medicine: Paving the Way to Health Through Our Forks	American Journal of Lifestyle Medicine
Allen-Winters et al. (2020)	USA	"Eat to Live"-Piloting a Culinary Medicine Program for Head and Neck Radiotherapy Patients	Supportive Care in Cancer
Knol, Lawrence and de la (2020)	USA	Eat Like a Chef: A Mindful Eating Intervention for Health Care Providers	Journal of Nutrition Education and Behavior

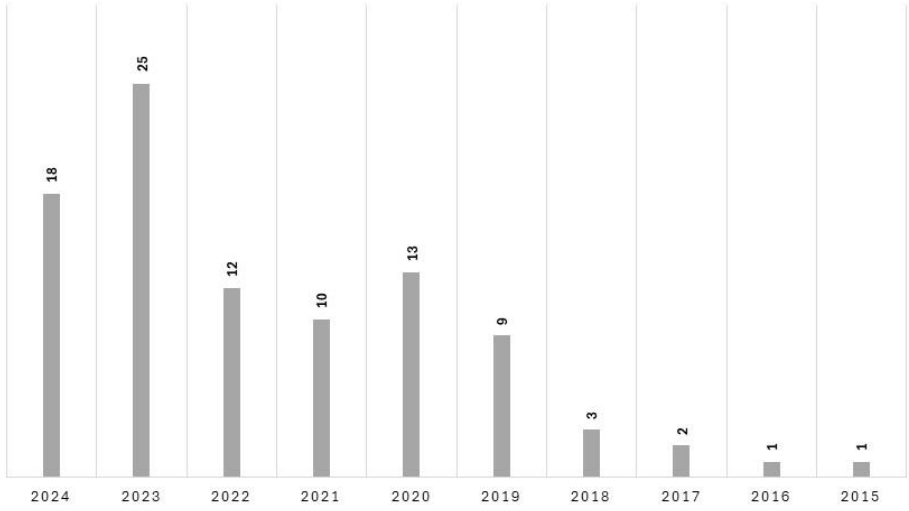
Farmer et al. (2020)	USA	A community feasibility study of a cooking behavior intervention in African-American adults at risk for cardiovascular disease: DC COOKS (DC Community Organizing for Optimal culinary Knowledge Study) with Heart	Pilot and Feasibility Studies
Vanderpool et al. (2020)	USA	Culinary medicine an evaluation to assess the knowledge, attitudes, behaviors, and confidence of first-year medical students in a culinary medicine teaching kitchen	Topics in Clinical Nutrition
Puma (2020)	USA	Culinary Medicine and Nature: Foods That Work Together	American Journal of Lifestyle Medicine
Klein and Parks (2020)	USA	Home Meal Preparation: A Powerful Medical Intervention	American Journal of Lifestyle Medicine
Olfert, Wattick and Hagedorn (2020)	USA	Experiences of Multidisciplinary Health Professionals From a Culinary Medicine Cultural Immersion: Qualitative Analysis	Health Professions Education
Matthews (2020)	Australia	Health Coaching as an Intervention for Picky Eaters	American Journal of Lifestyle Medicine
Van Horn et al. (2019)	UK, USA	Advancing Nutrition Education, Training, and Research for Medical Students, Residents, Fellows, Attending Physicians, and Other Clinicians: Building Competencies and Interdisciplinary Coordination	Advances in Nutrition
Ring et al. (2019)	USA	Cooking Up Health: A Novel Culinary Medicine and Service Learning Elective for Health Professional Students	Journal of Alternative and Complementary Medicine
Pang et al. (2019)	USA	Culinary medicine and community partnership: hands-on culinary skills training to empower medical students to provide patient-centered nutrition education	Medical Education Online
Irl et al. (2019)	USA	Culinary Medicine: Advancing a Framework for Healthier Eating to Improve Chronic Disease Management and Prevention	Clinical Therapeutics
Lu et al. (2019)	USA	Mixed spices at culinary doses have prebiotic effects in healthy adults: A pilot study	Nutrients
Hauser (2019)	USA	A Novel Culinary Medicine Course for Undergraduate Medical Education	American Journal of Lifestyle Medicine
Kakareka et al. (2019)	USA	Fresh and Savory: Integrating Teaching Kitchens with Shared Medical Appointments	Journal of Alternative and Complementary Medicine
Lang et al. (2019)	USA	Community Culinary Workshops as a Nutrition Curriculum in a Preventive Medicine Residency Program	MedEdPORTAL: the journal of teaching and learning resources
Wetherill et al. (2019)	USA	Development and Evaluation of a Nutrition-Centered Lifestyle Medicine Curriculum for Physician Assistant Students	Medical Science Educator
Golubić et al. (2018)	USA	Comprehensive Lifestyle Modification Intervention to Improve Chronic Disease Risk Factors and Quality of Life in Cancer Survivors	Journal of Alternative and Complementary Medicine
Jaroudi et al. (2018)	USA	Impact of culinary medicine elective on medical students' culinary knowledge and skills	Baylor University Medical Center Proceedings
Dreibelbisand George (2018)	USA	"Low-Hanging Fruit": Enhancing Culinary Medicine Curricula by Building Intuitive Community Partnerships	Medical Science Educator
Polak et al. (2017)	USA	Improving patients' home cooking - a case series of participation in a remote culinary coaching program	Applied Physiology,

			Nutrition and Metabolism
Dreibelbis and George (2017)	USA	Integrating Intergenerational Mentoring into a Culinary Medicine Curriculum	Medical Science Educator
Crawford and Aspry (2016)	USA	Teaching Doctors-in-Training About Nutrition: Where Are We Going in 2016?	Rhode Island medical journal (2013)
Monlezun et al. (2015)	USA	Medical school-based teaching kitchen improves HbA1c, blood pressure, and cholesterol for patients with type 2 diabetes: Results from a novel randomized controlled trial	Diabetes Research and Clinical Practice

Results and Discussion

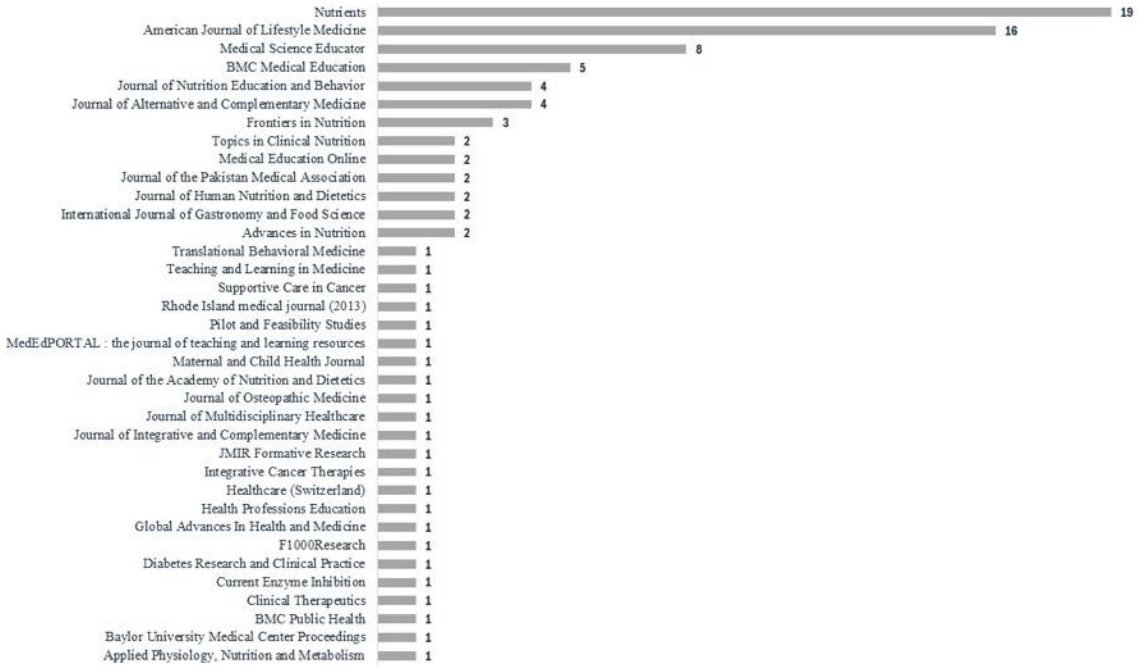
In order to address the research questions, a total of 94 articles were obtained from a search of the Scopus database based on the "culinary medicine" keyword search. Information such as publishing year, published journal, title of the research, authors, affiliation, and citation were used to explore the co-authorship, co-occurrences, citation, and thematic patterns. A review of the publishing history reveals that the theme of culinary medicine as a research area was first explored in 2015. A review of the distribution of published articles revealed that, over the past five years, research in the field of culinary medicine has emerged and grown rapidly, accounting for 92.5% of all published articles in this area (Figure 1).

Figure 1. Yearly distribution of the published culinary medicine research.



A total of 36 journals, comprising 94 articles, have published studies on the subject of culinary medicine in the Scopus database. The results demonstrated that *Nutrients* (n=19, 20.2%) and the *American Journal of Lifestyle Medicine* (n=16, 17.0%) have the highest publishing record, followed by *Medical Science Educator* (n=8, 8.5%) and *BMC Medical Education* (n=5, 5.3%). Figure 2 provides a summary of the distribution of published culinary medicine studies based on the journal in question. *Nutrients* journal ranked 18/114 under the title of the "Nutrition and Dietetics" with an impact factor 4.8 in 2023.

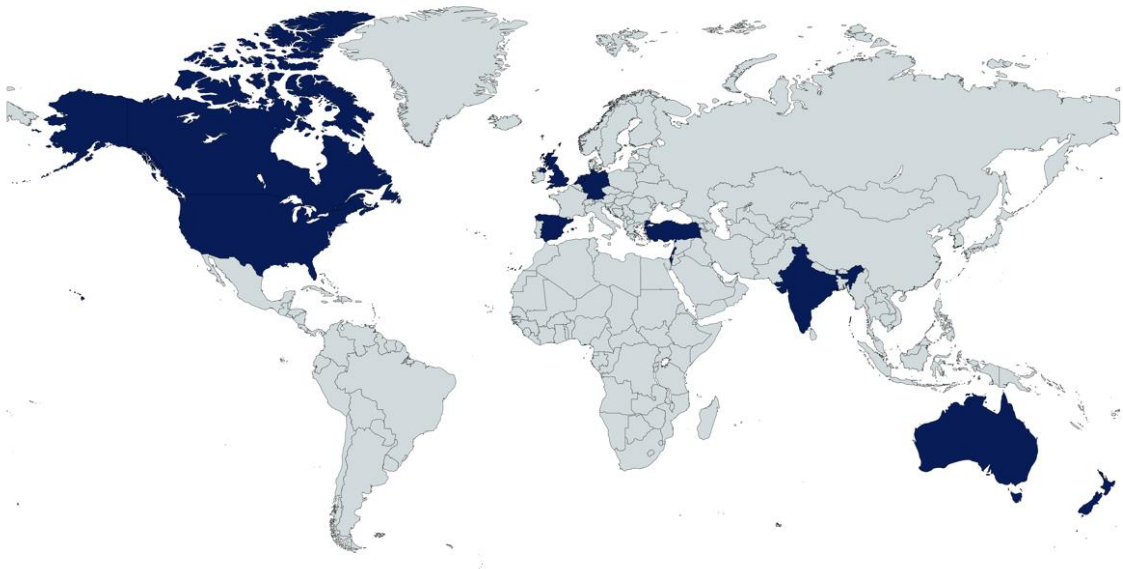
Figure 2. Distribution of the journals that published the research on culinary medicine.



The contributing countries

A further objective was to analyse the countries that contributed to the field of culinary medicine research. Figure 3 illustrates the distribution of countries of affiliation of the authors of the articles published in peer-reviewed journals. The results indicate that the United States is the country that has made the greatest contribution, with a total of 79 affiliations. This is followed by Australia (9), India (4), Spain (3), Canada and Israel (2). The remaining countries, namely Turkey, Germany, New Zealand, the Netherlands, Lebanon and the United Kingdom, have one affiliation each.

Figure 3. The contributed countries. Source: It was created by author by using www.mapchart.net



The most cited documents in journals – top 10

The most frequently cited articles published were also investigated based on data from the Scopus database. The ten most frequently cited studies were examined in terms of the methodology employed and the research theme, as illustrated in Table 3. The article that received the greatest number of citations was published in

2019 by Van Horn et al. and concerned the education and training of professionals in the field of culinary medicine. At the time of data collection, the total number of citations was 61. The second most frequently cited paper (n=54) was published in 2015 by Monlezun et al. and was based on the utilisation of a teaching kitchen to enhance the culinary abilities of medical school students. The majority of the cited studies were based on the education of medical school students, with other professions such as physicians, nurses, dietary consultants, and clinical practitioners also represented. The majority of these studies conducted preliminary investigations or case studies to assess the enhancement of students and the impact of culinary medicine education or training during the educational phase.

Table 3. The most cited articles on culinary medicine research field.

Author	Title	Published Journal	Cited by
Van Horn et al. (2019)	Advancing Nutrition Education, Training, and Research for Medical Students, Residents, Fellows, Attending Physicians, and Other Clinicians: Building Competencies and Interdisciplinary Coordination	Advances in Nutrition	61
Monlezun et al. (2015)	Medical school-based teaching kitchen improves HbA1c, blood pressure, and cholesterol for patients with type 2 diabetes: Results from a novel randomized controlled trial	Diabetes Research and Clinical Practice	54
Ring et al. (2019)	Cooking Up Health: A Novel Culinary Medicine and Service Learning Elective for Health Professional Students	Journal of Alternative and Complementary Medicine	36
Pang et al. (2019)	Culinary medicine and community partnership: hands-on culinary skills training to empower medical students to provide patient-centered nutrition education	Medical Education Online	34
Sharma et al. (2021)	Impact of a virtual culinary medicine curriculum on biometric outcomes, dietary habits, and related psychosocial factors among patients with diabetes participating in a food prescription program	Nutrients	33
Irl et al. (2019)	Culinary Medicine: Advancing a Framework for Healthier Eating to Improve Chronic Disease Management and Prevention	Clinical Therapeutics	30
Magallanes et al. (2021)	Nutrition from the kitchen: culinary medicine impacts students' counseling confidence	BMC Medical Education	29
Eisenberg and Imamura (2020)	Teaching Kitchens in the Learning and Work Environments: The Future Is Now	Global Advances In Health and Medicine	28
Lu et al. (2019)	Mixed spices at culinary doses have prebiotic effects in healthy adults: A pilot study	Nutrients	28
Rothman et al. (2020)	A Culinary Medicine Elective for Clinically Experienced Medical Students: A Pilot Study	Journal of Alternative and Complementary Medicine	25
Hauser (2019)	A Novel Culinary Medicine Course for Undergraduate Medical Education	American Journal of Lifestyle Medicine	23

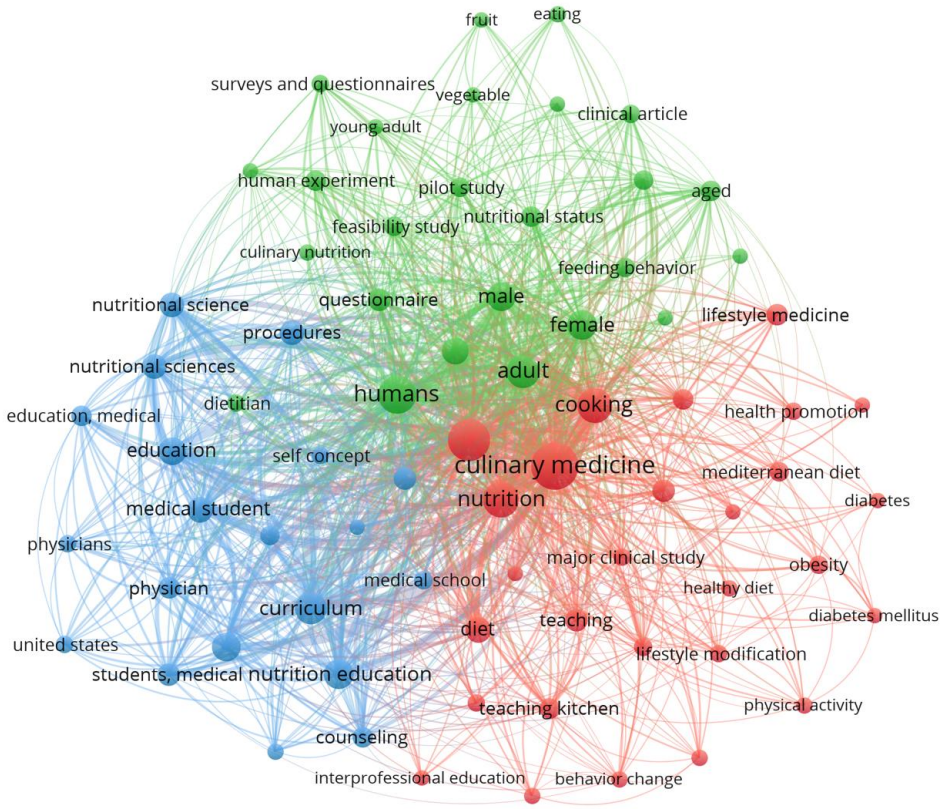
Author keywords analysis

In order to evaluate the primary research themes of the published articles, a co-occurrence analysis of author keywords was conducted using the Vosviewer software. The analysis of co-occurring keywords generates nodes, with the size of the nodes reflecting the frequency of citations. The link between the two nodes demonstrates the significance of the co-occurrences, while the thicker line represents the number of occurrences. The use of different colours for the lines reflects the different clusters, as proposed by Wang et al. (2020). Upon completion of the analysis, three distinct clusters were identified, each represented by a different colour: cluster 1 (red), cluster 2 (green) and cluster 3 (blue) which are shown in Figure 4.

Cluster 1 is a knowledge assessment cluster that demonstrates the relationship between dietary habits and culinary practices as a means of promoting a healthy lifestyle and preventing the onset of disease. The most frequently occurring keywords were "human" (n=67), "nutrition" (n=45), and "cooking" (n=41). The studies included in Cluster 1 contribute to the advancement of knowledge regarding the importance of culinary medicine (Croxford et al., 2024), the implementation of healthy cooking practices, and the interplay between culinary and nutritional values of food (Puma, 2020). Furthermore, these findings facilitate the formulation of constructive behavioural modifications (McWhorter et al., 2022b) and impart detailed culinary techniques, while also employing unconventional methods to address specific foodstuffs or ingredients as a potential remedy for various ailments (Parks and Polak, 2019, Kalra, Prisco and Parikh, 2023). Cluster 2 represents the methodology employed in the research and the characteristics of the sample set. The most frequently occurring keywords were "humans" (n=51), "adult" (n=36), "female" (n=29), and "male" (n=26), which were used to describe the characteristics of the sample set and the manner in which the data were collected. The methods implied during the research was generally based on the pre- and post-surveys or questionnaires to assessed nutrition knowledge, skills, nutiritional counselling, and attitudes (D'adamo et al., 2021). There are also some pilot studies for further innovation and seeking solutions for diet-sensitive diseases (Albin, Siler and Kitzman, 2023).

Cluster 3 encompasses the education of the culinary medicine field across different disciplines. The researchers identified curriculum (n=33), nutrition education (n=28), and medical education (n=25) as themes related to the integration of culinary medicine education into medical or nutrition schools. The findings provide education trainings curriculum development, formal medical school curricula to outpatient shared, teaching kitchen (Monlezun et al., 2015, Dreibelbis and George, 2017, Kakareka et al., 2019), cooking labs (Jaroudi et al., 2018) live online courses (Sommer et al., 2023; Charles et al., 2023), virtual cooking class (Ai et al., 2024) or remote coaching (Doxey et al., 2023, Albin et al., 2024). Humerick et al. (2024) developed a Culinary and Lifestyle Medicine Track (CLMT) tool in medical education to teach concepts of wellness under the titles of healthy nutrition, physical activitiy, stress management and restorative sleep. The findings provided that the mostly defined sample set is based on the medical students (Stauber et al., 2022; Tan et al., 2022, D'Adamo et al., 2022), followed by dietitians and physicians (Albin, Siler, and Kitzman, 2023; Maker-Clark et al., 2023).

Figure 4. Co-occurrence of the author keywords of published articles.



Limitations of the study

The objective of this study was to gain insight into the current research trends and themes in the domain of culinary medicine through the use of bibliometric analysis. It should be noted that the analysis is subject to certain limitations, including the fact that the data used in this study were obtained exclusively from the Scopus database, which may limit the generalizability of the findings. To enhance the robustness of the findings, it would be advantageous to supplement the data from this study with information from other reliable databases, such as Web of Science (WOS) and PubMed resources. Secondly, the selection of articles for further analysis was restricted to English-language articles that have undergone a peer review process. The authors meticulously read and reviewed the relevant articles, thereby ensuring that only English-language articles were selected for further analysis. Finally, the threshold value employed for the documents utilized in the Vosviewer software may yield disparate results depending on the researcher's identification.

Future Directions

A recent increase in the number of culinary education programmes embedded within academic curricula in medicinal faculties has been indicated by bibliometric and keywords analysis. This proliferation signifies the mounting recognition of culinary medicine and the imperative for standardising curricular components, optimal practices, and evaluation strategies (Mallya, Thirugnanasambantham and Shettigar, 2023). This standardisation is crucial for ensuring the standard of culinary education, sustainability, and the impact on promoting a healthy lifestyle (Newman et al., 2023). The analysis performed in this study suggests that the incorporation of culinary applications in the domain of medical education, as well as in the field of gastronomy education, is a pivotal factor in enhancing the standardisation of culinary medicine studies. The authors of this study propose the undertaking of future research in the area of culinary medicine practices, with the objective of furthering the understanding of nutrition and malnutrition, and thereby contributing to the enhancement of awareness concerning the sustainable development goals. The future studies will be meticulously planned to align with the nutrition, gastronomy and medicine triangle, thereby ensuring a comprehensive and

interdisciplinary approach to research. The research will identify the challenges and opportunities to increase or develop gastronomy and medicine students in the field of culinary medicine. In the context of digitisation in daily life, the utilisation of digital tools in the domain of culinary medicine education has the potential to enhance home education. This development holds the prospect of enhancing the education of the population in terms of health by incorporating home cooking skills into the curriculum, with the aim of preventing disease.

In this study, the necessity of developing an education in culinary medicine that is aligned with the training of culinary medicine chefs who will serve as instructors in this field is emphasised. The identification and study of best practices and culinary applications in the field of culinary medicine are deemed essential for future research. The establishment of an interdisciplinary environment comprising health professionals, dieticians and chefs is proposed as a means of enhancing understanding of the connections between these research areas. In conclusion, the authors propose that the incorporation of needs into daily dietary trends or alterations, in conjunction with the foods provided, as part of farm-to-fork strategies, will enhance the utilisation of culinary medicine in the context of sustainability. They further propose that research focusing on local food, in alignment with culinary medicine applications, will facilitate the identification of challenges in local areas.

Conclusion

The present study was designed to implement a bibliometric and keywords analysis of the last decade. A preliminary analysis of the published article data set indicated that, from the beginning of 2020, culinary medicine education had become widely integrated into the curriculum of medical schools. The majority of culinary medicine studies were conducted in the United States. Furthermore, studies investigated the potential of menu redesign and mindful eating as strategies for preventing depressive disorders, cardiovascular disease, and menopausal symptoms associated with the natural aging process. The pilot studies employed by the researchers also defined the multistakeholder collaboration of medical professionals, nurses, physicians, dietitians, and chefs (McWhorter et al., 2022; Donovan et al., 2023; Humerick et al., 2024). Furthermore, the utilisation of culinary medicine has been demonstrated not only in the training of professionals, but also for the benefit of families affected by obesity (Johnston et al., 2021), type 2 diabetes (Gayoso et al., 2023), and for the enhancement of home cooking skills based on nutritional value for the purposes of wellness and a healthy life (Goni et al., 2022). Initiatives have also been launched with the objective of providing culinary medicine education for those teaching in culinary schools and high school students (Craven et al., 2023) and for low-income populations (McWhorter et al., 2022). Furthermore, the findings indicated that technological advancement and the increased utilisation of digital tools have begun to be employed in the context of patient-culinary medicine specialists. Virtual culinary medicine online courses for medical students have been developed (Poulton and Antono, 2021; Yousef et al., 2022; Doxey et al., 2022; Böttcher et al., 2023). The present study revealed that education in the field of culinary medicine has been improved and integrated into the curriculum of health and nutrition education at different levels, either as a learning module or elective course. The study also proved that not only the professions from the health industry but also patient education in this field has started to be implemented to raise the healthiness of society.

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