The Effectiveness, Impact, and Viability of Culinary Medicine in Medical Programs: A Systematic Review

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Abstract

Background: Dietary modifications are considered a first-line intervention for chronic disease management, yet graduating doctors still report not feeling competent to counsel patients on their diet. Research has focused on methods to address this shortfall in physician competency, including culinary medicine. Culinary medicine is an approach to education that involves hands-on food and cooking learning experiences to equip participants with tools for improving the nutrition behaviour and health of their future patients. Despite positive findings in the efficacy of these interventions, they differ markedly in approach and target, leading to difficulties in deriving a global standardised curriculum.

Methods: This systematic review aims to address this inconsistency by synthesising existing literature on culinary medicine interventions that are offered during medical training; specifically, those with a hands-on culinary skills component. This entails an assessment of the effectiveness, impact, and viability of such programs as well as a comparison to existing curricula to provide specific recommendations for future programs.

Results: The findings of this research demonstrate a clear increase in interest in the use of hands-on culinary medicine programs as educational tools, evidence of feasibility in implementation, and improved student nutritional knowledge, skill and counseling compared to a traditional didactic curriculum. However, variations exist in delivery method, setting, and course content between programs. There is also lack of program cost reporting and long-term follow up of participants, inconsistent evidence for improved nutrition attitudes amongst participants, as well as geographically limited adoption of such programs.

Conclusions: By searching the current literature body for programs that address hands-on culinary skills within the context of medical education, this study reveals the potential benefits and existing shortcomings of such programs. These findings will guide future research towards legitimising culinary medicine into globally accepted standards for medical education.

Background

Chronic disease accounts for 41 million deaths annually, equivalent to 71% of all deaths globally. Poor dietary habits and lifestyle behaviours are leading modifiable risk factors for chronic diseases.¹ Nutrition care is the practice of improving the nutrition behaviour and health of patients conducted by health professionals.² As a result, nutrition care that supports patients to eat well is considered as an essential, first line step in preventing and managing chronic disease.¹ However, doctors report not feeling equipped to provide adequate nutrition care to patients, despite their acknowledgement that nutrition is a useful and necessary part of patient care.^{2,3}

Interest in culinary medicine has rapidly increased among many medical schools across the United States and other countries as a potentially low-cost, high impact strategy to equip students with practical nutrition skills that can be employed for nutrition care in clinical settings.⁴ Several pilot culinary medicine

programs have occurred⁵ which theorise that the initiatives may lead to doctors feeling more confident providing nutrition care.⁶ These programs have demonstrated significant and positive impact on medical student's attitudes, knowledge, and competencies with practical, hands-on culinary skills and nutrition knowledge, which ultimately supports their patient counselling.⁷ Many aspects of these pilot programmes are unique and wide difference exists in structure, duration, and setting between programs. While these programs provide a wide range of suitable information, they are not helpful for recommending a standardized implementation of culinary medicine in medical programs. For this to happen, the effectiveness, impact and viability of culinary medicine warrants further exploration to be clearly understood.⁸ This systematic review aims to synthesise the existing literature on Culinary Medicine offered to medical students within their four years of medical school education.

Methods

Overview

This systematic review critically synthesised literature examining culinary medicine programs offered to medical students in medical education and training. The review was informed by methodological guidelines. The protocol was registered with PROSPERO (ID: CRD42020210766) and the reporting followed PRISMA guidelines.⁹

Search Strategy

An electronic literature search was conducted between June and August 2020 with the support of an academic librarian. Computer-based searches were conducted within MEDLINE, SCOPUS, Web of Science, Science Direct, Taylor and Francis, and SAGE. Search string terms consisted of "culinary medicine", "nutritional medicine", "culinary education", and "food as medicine" compounded with "medical student", "medical program", and "medical education". The search strategy was adapted to each database to include relevant MeSH headings, proximity searching and key words. The search strings for each database used has been provided in Appendix 2.

Selection Criteria

All full-text, peer-reviewed journal articles published in English prior to August 26 2020 were eligible for screening, for:

- *Population:* Medical students, or medical graduates if they received the intervention during medical school.
- *Intervention:* Any form of culinary medicine education (curriculum or elective) received during medical school. Culinary medicine was considered to be used if the article referred to the activity in that way, or if a practical/hands-on cooking related teaching experience occurred.

- *Comparison:* Studies must have had a control group (difference between groups) or baseline measures (difference over time).
- *Outcome Measures:* Changes in medical students' nutritional knowledge, skills, or attitudes were included relevant.

Preliminary title and abstract screening occurred on 50 records by importing the details into Microsoft Excel and screening by LB, TR, KS, LA, and JT to establish interrater reliability. Interrater reliability using the selection criteria was 98% and deemed sufficiently high to progress to screening.

All records were then imported to Covidence for screening. After duplicates were removed, the titles and abstracts for all articles were independently screened twice, by any two of the four researchers (TR, KS, LA, and JT), facilitated by the Covidence software system. Full-text articles were retrieved for 28 records which were independently assessed as relevant for further consideration by two researchers. Conflicting screening results were resolved during regular team meetings. An additional 16 articles were identified via ancestry searching and were manually added for screening. The screening process is outlined in figure 1 using the PRISMA 2020 diagram.⁹

Data extraction

Data extraction was performed in duplicate to describe the study characteristics, intervention/initiative, outcomes and impacts. Quantitative and qualitative studies were included in this systematic review and were analysed using meta-synthesis, an interpretation of results to offer novel information regarding the viability of culinary medicine in medical education.

Quality Appraisal

The methodological quality and reporting of each study was assessed independently, in duplicate using the CASP tool, version 2020.¹⁰ CASP has specific appraisal checklists designed for different study designs, both within the study and across studies, making it an appropriate tool for this systematic review. Agreement was reached on all of the appraisal items. With regards to satisfying each CASP criteria, papers were assigned a score of 0 for 'yes', 1 for 'can't tell' and 2 for 'no'. The CASP scores were a sum of the individual criterion scores for each paper. Where scores differed, discrepancies were resolved through team discussions.

Results

A total of 1784 articles were screened by their title and abstract and 32 articles were reviewed as a full-text. Of these articles, 12 met the criteria and were included in the systematic review.

Reasons for excluding articles reviewed as full-text included wrong study design (n=10),¹¹⁻²⁰ wrong population (n=2),²¹ a failure to report any outcome measures (n=2),^{8, 22} wrong intervention (n=3),²³⁻²⁵ and two studies were found to be a duplicate data set.^{26, 27} Of the 12 included studies, the majority were

qualitative studies (n=4)²⁸⁻³¹ or cross-sectional studies (n=4),³²⁻³⁵ and the remainder were prospective case series studies (n=2),^{36,37} a case study (n=1)³⁸ and a mixed-methods study (n=1).³⁹

All 12 studies were conducted in the United States of America (USA) and ranged from four²⁸ to 4215 participants.³⁵ Ten studies involved medical students only,^{28, 30-36, 38, 39} five of which evaluated a single year cohort of students rather than a mixed cohort between years one through four of their medical program.^{28, 30, 31, 38, 39} Two studies involved medical students and medical registrars,^{35, 37} and one also included nutrition students.³⁷ All 12 studies had a didactic lecture component to their course and hands on culinary skill lessons and collaborative cooking sessions. A variety of other delivery methods were used amongst the studies including: case-based learning in groups (n=9);^{28-30, 33-35, 37-39} pre-course preparations in the form of pre-readings, videos, and assignments (n=10);^{28-30, 32-35, 37-39} pre-session quizzes (n=4);^{28, 32, 37, 38} and after-class assignments and homework (n=6).^{28-31, 38, 39}

Six studies reported the study population demographics, with participants from varying ethnicities and nutritional backgrounds.^{32-35, 38, 39} The recruitment process in the studies typically involved an open elective application (n=2),^{31, 38} or voluntary enrolment into the course (n=4).^{28, 29, 33, 36}

Most studies had an underpinning objective of using culinary medicine approaches to improve medical students' nutrition knowledge and counseling in a clinical environment to support chronic disease prevention and management (n=11).^{28-36, 38, 39} Most studies assessed medical students' culinary skills (n=2),^{36, 38} nutrition attitudes (n=6),^{29, 32, 33, 36, 38, 39} and provision of nutrition counseling to patients (n=5).^{29, 31, 33, 38, 39} Some studies assessed student collaboration amongst other populations, such as people in the community (n=4)^{28, 33, 38, 39} and other healthcare professionals, such as dietitians or future physicians (n=7).^{29-31, 36-39} In many of the studies practical nutrition education in the form of a culinary medicine program was compared against traditional nutritional education in the form of solely didactic teaching (n=7)^{29, 30, 33-37} and in some studies there was a focus on improving interprofessional and doctor-patient relationships (n=7).^{28, 30, 34, 35, 37-39}

Nine studies reported statistically significant improvements in outcomes and were therefore considered as effective.³¹⁻³⁹ Students' improvement in nutritional attitudes were reported in pre- and post-course surveys, four of which achieved statistically significant improvements,^{32, 33, 36, 38} two identified statistically significant improvement in culinary skills,^{36, 38} and five identified changes in competency providing nutritional counseling,^{29, 31, 33, 38, 39} four of which were statistically significant.^{31, 33, 38, 39} Pre- and post-course surveys from six of 12 of the included studies identified changes in personal health behaviors^{8, 32, 33, 36, 38, 39} and two studies reported student improvements in their ability to identify food by visual inspection.^{36, 39} Five of the 12 studies failed to mention any negative or non-significant outcomes within their results.^{28, 29, 35-37}

Four studies utilised interventions that were adopted by multiple faculties.³²⁻³⁵ The interventions were implemented within a number of different settings. The most common settings were teaching kitchens (n=8)³²⁻³⁹, community kitchens (n=4)^{28, 33, 38, 39} and off site kitchens (n=6).^{28-31, 33, 35} Only four studies explicitly stated that the interventions met or exceeded the recommendation that US medical education include 25 hours in nutrition education.^{32, 34, 35, 37, 40}

The curriculum offered to students in each study varied by session layout, duration, type of instructor/instructors, and whether courses were offered as an elective (n=11)^{28, 29, 31-39} or non-elective course (n=1).³⁰ Half of the interventions were based on an established program, CHOP from Tulane University (n=6)^{28, 32-35, 37} and others used an original program (n=6).^{29-31, 36, 38, 39} Four studies reported modifications in their curriculum between cohorts with all changes made to address student feedback.^{30, 31, 38, 39} Nine studies had chef instructors,^{28, 29, 31, 34, 36-39} five studies included physicians as instructors,^{29, 31, 35, 37, 39} six studies included instructors from the school of medicine faculty,^{28-30, 35, 37, 38} and five studies from the school of nutrition faculty,^{29, 31, 34, 35, 37} three studies involved instruction from hospital dietitians;^{36, 37, 39} and two studies included medical students teaching peers.^{36, 39} Three studies included a service component where medical students taught and/or served members of the community.^{30, 32, 39} Of all the included papers, only one reported observations from the facilitators on the programs themselves following completion of the course.

None of the included papers explicitly reported the complete cost of running these programs. In only one paper, the cost of cooking materials, in addition to the license for Tulane's culinary medicine curriculum were reported.²⁸

Quality Appraisal

The mean CASP score was 10.8 out of a possible 20 points for qualitative studies (median = 11, range = 8-13) and 4.7 out of a possible 24 (Median = 4.7, range = 0-7) for cohort studies. The most frequent item that was not achieved amongst the cohort studies was that the follow up of subjects was not sufficiently complete (6/7 studies),^{29, 32, 34, 35, 37} with the most common reasons including unclear reporting or high attrition rates of participants. Many of the cohort studies also lacked an acceptable recruitment method (5/7 studies),^{29, 32, 34, 36, 37} with the most common reasons including unclear reporting, lack of inclusion/exclusion criteria and the reliance of convenience sampling biased towards students with a 'voluntary' or 'elective' interest. Most studies failed to report attrition rates (n=8) and only one of these studies reported reasons why the participants failed to complete the course.

The overall poorer quality of the qualitative studies was related to the frequent absence of several CASP items in the studies. The relationship between the researchers and participants was poorly reported in all five qualitative studies, most frequently due to lack of reporting of any such considerations in the methodology.^{28, 30, 31, 38, 39} In addition, all included papers displayed poor consideration of ethical issues, either due to failure to mention any ethical considerations or having their ethical approval waived by the

institution.³⁸ All included papers also had an insufficiently rigorous analysis of data, most commonly due to a lack of data presented and analysis performed. The findings of the CASP quality appraisal, with reasons for negative scoring per criterion, are described in Tables 1 and 2.

Table 1 Qualitative study appraisal					
Criterion	Dreibelbis & George, 2017;	Ring et al., 2019;	Pang et al., 2019;	Hennrikus et al., 2020;	Rothman et al., 2020;
Was there a clear statement of the aims of the research?	Yes	Yes	Yes	Yes	No ^a
Is a qualitative methodology appropriate?	Can't Tell ^b	No ^{c/d}	Yes	Can't Tell ^b	Yes
Worth Continuing?	Yes	No ^{c/d}	Yes	Yes	Yes
Was the research design appropriate to address the aims of the research?	No ^a	No ^{c/d}	Yes	Yes	No ^e
Was the recruitment strategy appropriate to the aims of the research?	No ^a	No ^d	No ^c	Yes	Yes
Was the data collected in a way that addressed the research issue?	Can't Tell ^{a/b}	Yes	Yes	Can't Tell ^b	No ^g
Has the relationship between researcher and participants been adequately considered?	No ^{a/f}	No ^a	No ^a	No ^a	No ^a
Have ethical issues been taken into consideration?	Can't tell ^a	No ^a	No ^a	No ^a	No ^a
Was the data analysis sufficiently rigorous?	No ^{a/b/f/g}	No	No ^{b/f}	No ^{b/f}	Can't tell ^g
Is there a clear statement of findings?	No ^g	Yes	No ^f	Yes	Yes
Uncertainty Score	13	12	10	8	11
Reasons: ^a Not reported; ^b Selection bias/Convenience sampling/Elective course; ^c Poorly designed surveys; ^d Inadequate controlling for multiple confounders; ^e High attrition rate; ^f Not performed; ^g Poor overall quality of study; ^h Low sample size.					

Table 2 Cohort study appraisal							
Criterion	Monlezun et al., 2015;	Jaroudi et al., 2018;	Monlezun et al., 2018;	Lawrence et al., 2019;	Hauser, 2019;	Patnaik et al., 2020;	Razavi et al., 2020;
Did the study address a clearly focused issue?	Yes	Yes ^a	Yes	Yes	Yes	Yes	Yes
Was the cohort recruited in an acceptable way?	Yes	Can't Tell ^b	Yes	Can't Tell ^a	Can't Tell ^a	Can't Tell ^b	Can't Tell ^b
Worth Continuing?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the exposure accurately measured to minimise bias?	Yes	Yes	Yes	Yes	Yes	Can't Tell ^b	Can't Tell ^b
Was the outcome accurately measured to minimise bias?	Yes	Yes	Yes	Yes	Can't Tell ^a	Can't Tell ^b	Can't Tell ^c
Have the authors identified all important confounding factors?	Yes	Yes	Yes	Yes	Can't Tell ^a	Yes	Yes
Have they taken account of the confounding factors in the design and/or analysis?	Yes	Can't Tell ^d	Yes	Can't Tell ^{c/e}	Can't Tell ^a	Yes	Yes
Was the follow up of subjects complete enough?	Yes	No	Can't Tell ^a	No	Can't Tell ^a	Can't Tell ^f	Can't Tell ^f
Was the follow up of subjects long enough?	Yes	Can't Tell ^a	Can't Tell ^a	Can't Tell ^a	Yes	Can't Tell ^f	Can't Tell ^f
Do you believe the results?	Yes	Yes	Yes	Yes	Can't Tell ^{g/h}	Yes	Yes
Can the results be applied to the local population?	Yes	No ^{h/g}	Yes	No ^{h/g}	Can't Tell ^{g/h}	Yes	Yes
Do the results of this study fit with other	Yes	Yes	Yes	Yes	Yes	Yes	Yes

available evidence?							
Uncertainty Score	0	7	2	7	7	5	5
Reasons: ^a Not reported; ^b Selection bias/Convenience sampling/Elective course; ^c Poorly designed surveys; ^d Inadequate controlling for multiple confounders; ^e High attrition rate; ^f Not performed; ^g Poor overall quality of study; ^h Low sample size.							

Discussion

This study is the first to advance understanding of current opportunities and obstacles for culinary medicine within the context of medical education, by examining the impact of culinary medicine in medical programs using a systematic approach. There is a clear interest in the use of culinary medicine as an education tool as indicated by nine separate culinary medicine initiatives identified in our review. Furthermore, current pilot and trial implementations indicate promising efficacy towards improving medical students' nutritional knowledge, skills and attitudes.^{31, 32, 38, 39}

Majority of included studies were published in the last half decade and achieved some statistically significant outcomes that promote a hands-on method of nutritional education over traditional didactic methods to educate students to help combat chronic disease as future physicians. Current literature is in line with the growing interest in culinary medicine programs, citing its emergence to the inadequacies of conventional education in combatting the rising burden of chronic disease in the healthcare sector.^{5, 23} This review demonstrates clear interest in the use of hands-on culinary medicine initiatives, as an educational tool and replacement for the standard curriculum of medical students. Given the relative recency of the published research, this review provides incentive for medical educators to continue to innovate and implement culinary medicine initiatives into medical education. Overall, it must be noted that, the current literature reflects poorer quality of studies, large ranges in sample size with varied results, and choice of study designs (mainly qualitative, pilot-studies). In addition, all included papers in this review were published in the USA, which may suggest that the increasing interest in culinary medicine appears limited in geographical footprint. However, this focus on the USA highlights an opportunity for broader international involvement to legitimise the culinary medicine curriculum as a relevant approach for nutrition training in medical education.

All 12 culinary medicine programs had a didactic component, with 10 programs utilising pre-coursework and nine programs also utilising a case-based group learning format in addition to the hands-on component. While this is the first study to explicitly compare delivery methods of culinary medicine programs, problem based learning, lecture sessions (live or recorded), and pre coursework are commonplace in medical school curricula, and have been proven as effective means for educating medical students.^{41,42} Hence, it seems reasonable that this delivery method would be adequate for delivery of culinary medicine teaching in combination with hands on kitchen sessions, providing further merit to the feasibility and implementation of hands-on culinary medicine programs. However, there were

also several variations both in the delivery method (i.e., pre-session quizzes, homework, community involvement, multidisciplinary faculty), setting (i.e., faculty resources, community resources), and aspects of culinary medicine taught (knowledge, skills, attitudes). These variations in culinary medicine programs have been well documented in the literature, leading to a myriad of considerations necessary to planning an effective intervention.¹⁸ Given that the few studies which acquired data across multiple universities as part of their curriculum³¹⁻³⁴ all sourced their curriculum from Tulane University's Cooking for Health Optimization with Patients (CHOP) curriculum, there is an evident scarcity of a globally accepted standardised curricula. This further exemplifies the need to provide clear objectives to guide future interventional studies and for medical schools interested in utilising culinary medicine to integrate the key principles adopted by schools, with established curricula, such as those from Tulane University.⁴³

None of the included studies reported the total cost of running the program or performed any cost analysis. Only one study reported the costs of cooking materials, and license for Tulane's culinary medicine curriculum.²⁸ While previous studies have attempted to address this gap in the literature by directly inviting program directors to comment on program costs/funding among other aspects, the majority of directors elected to provide approximate round figures without further cost breakdown, or simply elect to classify program cost as confidential.¹⁶ Regardless of cost-benefit or cost-effectiveness analyses, lack of reporting for simple expenditures in most interventions makes it challenging to assess whether culinary medicine initiatives can be integrated into existing medical programs as the costs associated with personnel, facilities and equipment/consumables may vary significantly between programs and location. While this is likely due to most studies being pilot studies, a medical qualification is already among the most expensive university programs available to students worldwide, and costs continue to increase at the expense of accessibility.⁴ Given the scarcity of outcome data and the intrinsic difficulty in comparing learning outcomes in the context of future benefit to patients combined with the ethical and epistemological difficulty in performing a cost benefit/effectiveness analysis in the setting of medical education, it is recommended that at minimum future studies provide data relating to the monetary costs; allowing the possibility of cost-benefit meta-analyses to be performed once higher quality data related to outcomes are published.⁴

In studies which assessed students' nutrition competencies, significant improvements were reported when compared to traditional teaching methods. The key difference was that culinary medicine curricula offers hands-on practical components and case-based learning as shown in Table A1 (Supplementary material). These practical culinary components are analogous to lab-based experiential learning, allowing students to apply theoretical knowledge to simulate real-world patient cases and to "learn by doing", - an effective method for clinical knowledge translation.^{46, 47} Other possible reasons for the improved competency outcomes arise from multidisciplinary faculty and community service components that together helped to increase students' understanding in applying practical nutrition and dietary advice in a community context.⁴⁸ Given that physicians play a key role in advising patients in nutrition, enhanced nutrition counselling skills will be effective for improving long term health outcomes for patients struggling with diet, weight loss, diabetes, and other chronic health problems.⁴⁹ If increased nutrition

counselling competencies gained through culinary medicine programs can be maintained into vocational practice, future doctors will be better equipped to shoulder or even reduce the incoming burden that chronic diseases poses for healthcare systems.⁵⁰

While it is promising that increased confidence in culinary skills and nutrition knowledge were demonstrated through participation in culinary medicine programs, none of the included studies sought longer-term follow-up with participants, limiting current understanding of the enduring effects of these interventions. This is an important consideration. Current quantitative studies are limited to cross-sectional methodologies, which under the *Levels of Evidence Framework*, form the lowest level evidence in establishing causation, but provide a basis for future study designs to incorporate stronger forms of evidence.⁵¹ Since the ultimate objective for culinary medicine programs is, positive clinical practice outcomes, it would be ideal for future studies to provide more robust evidence when investigating the impact of nutritional competencies gained within a culinary medicine program correlating or translating to better nutrition counselling in practice. Longitudinal studies would be required that track participants post-graduation and involve suitable controls for comparison, which could be a challenging aspect of study design.

The findings of surveys on students' attitudes towards nutrition counselling showed mixed results. Two studies identified negative findings, which while initially surprising, were partially explained by examining the recruitment methods used. In Pang et al. (2019) suitable participants were assessed by application essays, allowing course conveners to select participants based on perceived interest, resulting in potential selection bias. Furthermore, the majority of studies reviewed were electives. Together, these two factors indicate strong selection bias, that of course conveyors selections and participants' personal inclinations, and resulted in high positive pre-course scores on attitudes towards nutrition and nutrition counselling and statistically non-significant results. These negative findings when analysed in tandem with post-course improvements in nutrition counselling competencies suggest that students' individual attitudes towards nutrition is not the largest factor contributing to their lack of nutritional knowledge to effectively counsel patients about diet. Nonetheless, future primary studies assessing culinary medicine programs should attempt to mitigate inherent selection bias and confounding results. Mitigation could potentially be achieved by implementing culinary medicine as a non-selective component with randomised participants and consequent non-participants as controls.

Strengths and limitations of this review

The included papers in this study were collated from multiple databases through keyword search strings to yield results relevant to the research question, which has the potential be too narrow in scope. Screening of 1856 relevant papers was performed manually through Covidence after establishing 98% interrater reliability for an initial 50 results. Whilst interrater reliability was high, the potential for exclusion of relevant papers for final review does exist to some extent. Given that culinary medicine is a relatively recent development in the context of medical pedagogy, all the primary research findings were the results from pilots and on-going trials with limited longitudinal data and differing methodologies. Despite the

best efforts to make data comparable by overlaying a systematic approach on qualifying studies, interpretation of results necessarily requires extrapolation to draw relevant pedagogical and clinical conclusions. These subjective effects were mitigated, in-part, by citing peer-reviewed papers that supported our analysis. Another consequence of disparate measurement methods between existing studies is the inability to apply quantitative statistical methods in a meaningful manner, such as regression analysis and heterogeneity calculations. Specific challenges to overcome this limitation include accounting for duplicity of results for papers involved in a same trial and determining which outcome performance measures to use. Moreover, publication biases could obfuscate true effects of culinary medicine interventions if significant results are published more often than non-significant findings. Furthermore, as many of the results in these trials are likely to have an impact on the continued institutional support of these pilot programs, there is a risk of confirmation biases from investigators. Although study quality was not used to exclude papers used for our review, we have modified the CASP protocol to obtain a numerical rank of study quality (Tables 1 and 2). Several steps within the CASP protocol requires assessors' judgement to determine if a criterion has been met and this process is inherently subjective and may vary between individuals.

While our search was performed in English, which is inherently biased towards the selection of papers produced in Anglophone countries or papers with English translations embedded, we recognise that there may be relevant papers in other languages that have been excluded. Tangential to this issue is the unintended isolation of papers reviewed to only the United States of America, which raises the question of generalisability of our findings towards medical teaching institutions in other countries.

Despite these limitations, this is the first systematic review of the literature on culinary medicine programs that detail existing culinary medicine program components, methods and results. Through our analysis, future investigations will be able to rely on a consolidated paper to determine appropriate study designs, types of data collection and analytical methodologies.

Conclusions

This paper identified a small but notable body of literature describing culinary medicine programs that have been implemented in medical schools and analysed their findings. Our results indicate that culinary medicine programs are a good initiative to pursue and can be delivered in a hands-on way that provides potential future clinical benefits for students and patients. Culinary medicine programs appear to be a feasible replacement for traditional didactic nutrition education and may be more effective than traditional didactic methods at improving student competency. Yet, despite growing interest in establishing culinary medicine curricula and positive pilot and trial data, there is still a lack of strong evidence to claim that culinary medicine programs are superior to traditional nutrition education in medical school. A lack of standardization between culinary medicine pilot studies further hinders comparability and the ability to extrapolate benefits.

While more research is needed to determine the viability of culinary medicine programs in medical education, the argument for implementation can be improved if future culinary medicine studies obtain stronger evidence and maintain consistent objectives and methodologies as established in current literature. Namely, maintaining consistency with competency scales, teaching staff mix, delivery methods and qualitative analytical methods. Future studies should also aim to report on program cost and provide long term follow up of participants.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

The datasets generated during and/or analysed during the current study are presented in Tables 2 and 3, found in the supplementary materials below. Raw data sets are available from the corresponding author on reasonable request.

Competing interests

We declare no competing interests.

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Author's contributions

All authors, JT, TR, KS, LA, JC, and LB were significantly involved in the conception and design of the review. JT, TR, KS, and LA did the literature search, review, data extraction, interpretation of the findings, and article writing-original draft and reviewing and editing. LB contributed to the initial data extraction to establish interrater reliability and provided supervision over the entire project. JT contributed to project administration. All authors contributed greatly to editing and approval of the final Article. All authors have agreed they are accountable for all aspects of the work.

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Figures

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Figure 1

PRISMA 2020 flow diagram

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