Lead Article

Impact of preconception, pregnancy, and postpartum culinary nutrition education interventions: a systematic review

Rachael M. Taylor, Julia A. Wolfson, Fiona Lavelle, Moira Dean, Julia Frawley, Melinda J. Hutchesson, Clare E. Collins, and Vanessa A. Shrewsbury

Context: *Frequent consumption of home-prepared meals is associated with higher diet quality in children and adults. Therefore, increasing the culinary skills of women and couples during their childbearing years may be an effective strategy for the prevention of overweight and obesity.* ***Objective:*** *To determine the impact of culinary nutrition-education interventions for women with or without their partners during preconception, pregnancy, or postpartum (PPP) on parental cooking skills, nutrition knowledge, parent/child diet quality, or health outcomes.* ***Data sources:*** *Eligibility criteria were defined using a PICOS framework. A systematic search strategy was developed to identify eligible studies and was implemented in 11 electronic databases. Reference lists of selected systematic reviews were manually searched for additional studies.* ***Data extraction:*** *Study characteristics and outcomes were extracted from eligible studies by 1 reviewer and checked by a second reviewer.* ***Data analysis:*** *A narrative synthesis of the findings of eligible studies was prepared including descriptive statistics. Reporting was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement and Synthesis Without Meta-Analysis in systematic reviews reporting guideline.* ***Results:*** *A total of 6951 articles were identified from the search strategy and 31 studies during pregnancy or postpartum were included. By category, the number of studies with a favorable outcome per total number of studies measuring outcome were as follows: parental food/cooking skills (n = 5 of 5), nutrition knowledge (n = 6 of 11), parent/child diet quality (n = 10 of 19), infant feeding (n = 6 of 11), eating behavior (n = 2 of 5), maternal (n = 2 of 5) and child anthropometry (n = 6 of 10), mental health and development n = (2 of 3), and clinical indictors (n = 1 of 1).* ***Conclusions:*** *Culinary nutrition-education interventions during pregnancy and the postpartum period show promise in improving cooking skills, diet quality, and a variety of health-related outcomes. The precise effect of these interventions during PPP is limited by the quality and heterogeneity of study designs to date.* ***Systematic review registration :*** *PROSPERO registration number: CRD42020154966*

Affiliation: *R.M. Taylor, M. Dean, J. Frawley, M.J. Hutchesson, C.E. Collins,* and *V.A. Shrewsbury* are with the School of Health Sciences, Faculty of Health and Medicine, Priority Research Centre for Physical Activity and Nutrition, The University of Newcastle, Callaghan, New South Wales (NSW), Australia. *J.A. Wolfson* is with the Department of Health Management and Policy, University of Michigan School of Public Health, Ann Arbor, Michigan, USA. *F. Lavelle* and *M. Dean* are with the Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast, Belfast, UK. *J. Frawley* is with the Nutrition & Dietetics Service, Frawley Nutrition, Lambton, NSW, Australia

Correspondence: *V.A. Shrewsbury*, Nutrition and Dietetics, Priority Research Centre for Physical Activity and Nutrition, The University of Newcastle, Level 3 ATC Building, Callaghan Dr, Callaghan, New South Wales 2308, Australia. E-mail: vanessa.shrewsbury@newcastle.edu.au.

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INTRODUCTION

Obesity is a global public health issue that is highly prevalent by late adolescence and early adulthood; it typically coincides with the commencement of the childbearing years. In high-income countries, the prevalence of obesity during early pregnancy ranges from 24% to 35%,[1–4] whereas in middle- and low-income countries, there is significant variation in the prevalence of obesity during pregnancy within and between countries.[5] For example, a meta-analysis (n = 29 studies) indicated that maternal obesity across Africa ranged from 6.5% to 50.7%.[6] Furthermore, evidence suggests that at least half of men have overweight or obesity before they enter fatherhood.[7,8]

Weight management is particularly important for women of reproductive age, because prepregnancy overweight and obesity and excessive gestational weight gain are associated with higher risks of maternal, perinatal, and neonatal complications.[9–11] Excessive gestational weight gain is also a leading risk factor for postpartum weight retention, which could contribute to the onset of overweight or obesity and adverse maternal and fetal outcomes in future pregnancies.[12–14] Evidence indicates that excessive maternal weight gain across the childbearing period is associated with childhood obesity in the offspring, which is a predictor of obesity in adulthood.[15–17] Obesity in men is associated with reduced sperm quality[18,19] and endocrine disturbances in their offspring.[20] Therefore, effective strategies for prevention of overweight and obesity in men and women of reproductive age are essential for promoting optimal health outcomes for the whole family.

Worldwide, poor dietary patterns are a key contributing factor to the development of overweight and obesity.[21,22] In the past 5 decades, the frequency of meals prepared at home has declined while the consumption of foods prepared outside the home (ie, fast food and restaurant food), which are typically higher in energy, fat and salt, has increased[23,24] Regular consumption of home-prepared meals is associated with higher diet quality across the lifespan.[25–27] Therefore, increasing the frequency of consumption of home-prepared meals is a key health behavior to target for the prevention of overweight and obesity in adults and children and has been the subject of significant research in the past 2 decades.[28–30]

Although women continue to spend more time cooking at home than do men,[31] the time they spend on preparing meals has been declining since the 1960s, due to women's entry into the workforce.[32–34] As a result, traditional household gender roles have changed, especially in high-income countries, with men more involved in domestic work, including cooking, compared with 5 decades ago.[32,34] This may have implications for the involvement of men in maternal care, because pregnant women expect their partners to provide assistance with cooking and encouraging healthy eating habits.[35,36] Beyond pregnancy, children are dependent on parents to provide a home environment that supports healthy eating behaviors, including the consumption of home-prepared meals.[37,38] However, children are less involved in the preparation of meals at home and, consequently, there is a lack of cooking skill transference between mother and child compared with previous generations, which may adversely affect child diet quality.[39,40]

Previously published systematic reviews have suggested that theoretical and hands-on cooking interventions are associated with short-term improvements in cooking confidence and skills, dietary intake, eating attitudes and behavior, food and nutrition knowledge, and health outcomes.[41–45] Findings from these reviews also indicated improvements in clinical measures, including blood pressure and fasting glucose levels[42,43]; however, these findings were based on descriptive summaries of the evidence. The only review that included a meta-analysis (n = 11 studies) found that cooking interventions were not associated with significant changes in body mass index (BMI) and blood pressure or cholesterol levels in children and adults.[46]

To our knowledge, no systematic reviews of culinary nutrition-education interventions have been conducted in which the specific population under analysis was limited to women with or without their partners during preconception, pregnancy, or the postpartum period (PPP). Given the positive impacts of culinary education interventions reported,[41–45] a review constrained to culinary nutrition-education literature in PPP is important for informing evidence-based interventions that target improvement in dietary quality and weight management during this critical life stage, which may affect the next generation. Therefore, with this systematic review, we aimed to determine the impact of culinary nutrition-education interventions for women with or without their partners during PPP on parental cooking skills and nutrition knowledge, and parent/child diet quality and health outcomes.

METHODS

The reporting of this systematic review was in accordance with the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement.[47] The review protocol (Table S1 in the Supporting Information online) was prospectively submitted to the International Prospective Register of Systematic Reviews (PROSPERO) for registration (PROSPERO identifier: CRD42020154966).[48]

Table 1 **PICOS criteria for inclusion of studies**

PICOS criterion	Inclusion criteria
Participants	Women with or without their partners, planning a pregnancy, currently pregnant or ≤ 5 years postpartum
Interventions	Theoretical or practical culinary nutrition education as a standalone intervention or a component of a multicomponent intervention
Comparisons	Single-arm and multiarm interventions (with a comparison intervention or nonintervention control group)
Outcomes	Parental cooking skills and nutrition knowledge, and parent and child diet quality and health outcomes
Study design	Experimental studies (eg, randomized controlled trials, quasi-experimental, pre- and post-test study with no control)

Eligibility criteria

The selection of studies for inclusion in this review was based on the participants, intervention, comparator, outcome, and study design (PICOS) criteria summarized in Table 1.

Participants. Studies were eligible for inclusion if participants were women (including or not including their partners) of any age who were planning a pregnancy (≤ 24 months preconception only), pregnant, or up to 5 years postpartum (including or not including their child or children). Studies that included a mix of participants ≤ 5 years postpartum and > 5 years postpartum were excluded unless the data from the former group could be extracted separately. Interventions that specifically targeted children and did not include the parents were excluded.

Intervention. Eligible study interventions included those that provided a practical (eg, cooking lesson or demonstration, knife skills practice for preparing food) or theoretical (eg, meal planning, written information about cooking techniques) culinary medicine, culinary nutrition, and cooking or culinary skills education of any duration. For the purposes of this review, the concept of *cooking* encompasses the practical skills (eg, chopping, mixing, sautéing) required to transform raw ingredients into cooked food, as well as cognitive skills, knowledge, and confidence associated with producing a meal, including meal planning, grocery shopping, making healthy food choices, and demonstrating hygienic food practices.[49,50] The definition of *culinary medicine* used here is "a new evidence-based field in medicine that blends the art of food and cooking with the science of medicine," and *culinary nutrition* refers to combined application of nutrition and food science with culinary arts.[51] Henceforth, interventions with these components are broadly termed *culinary nutrition-education interventions*.

Studies were included if the culinary education intervention was standalone or part of a multicomponent intervention delivered to the aforementioned population. Studies were excluded if an insufficient description of the cooking intervention was provided.[52,53] For example, if a study only reported that recipes were provided during the intervention but did not explain if and how they were used, this study would be excluded.

Comparator. Single-arm and multiarm interventions (with an comparison intervention or nonintervention control group) were eligible for inclusion. The outcomes for all group comparisons were included in the analysis.

Outcomes. Eligible measures included parental food and cooking skills and nutrition knowledge, and child and parent diet quality and health outcomes. *Nutrition knowledge* referred to the understanding and attitudes toward the diet and health relationship, nutrients and major food sources, and recommendations from national dietary guidelines. *Diet quality* included measures of energy and nutrient intake, the amount (eg, servings, grams) consumed of specific food groups (eg, vegetables), infant feeding, and eating behaviors. *Health outcomes* referred to measures of child development and health status (eg, anthropometry), including clinical indicators (eg, blood pressure, biochemical measures). Studies were included if ≥ 1 outcome measures were reported.

Study design. The following experimental study designs were included in the review: randomized controlled trials (RCTs), non-RCTs (including quasi-experimental or controlled clinical trial), cluster RCTs and case series (including pre- and post-test design or before-and-after studies with no control), and interrupted time series.

Search strategy

An electronic literature search strategy was developed in consultation with a senior medical research librarian. The literature search was conducted by the research librarian in October 2019 and was limited to studies published in the English language from 2000 to October 2019. This period was selected on the basis of the systematic review findings of Hasan et al,[46] which identified that culinary intervention studies in children and adults were predominately (97%) published during that time. The following databases (platforms) were searched: A+ Education (Informit, Melbourne, VIC, Australia), CENTRAL/Cochrane Trials (Wiley, Hoboken, NJ, United States), CINAHL (EBSCO, Ipswich, MA, United States), Cochrane Reviews (Wiley, Hoboken, NJ, United States), EMBASE (OVID, New York, NY, United States), ERIC (Proquest, Ann Arbor, MI, United States), Health Source-Consumer/Health Source-Nursing/Academic, Informit Health (Informit, Melbourne, VIC, Australia), Medline (OVID, New York, NY, United States), Public Health (Proquest, Ann Arbor, MI, United States), and Scopus (Elsevier, Amsterdam, Netherlands). Full details of the search strategy, including key words used for each database, and results can be found in Tables S2–S7 in the Supporting Information online. The reference list of identified systematic reviews including culinary interventions[41–43,46,54] was searched to crosscheck for any relevant studies that were not detected from the initial search strategy. All retrieved records from the aforementioned search strategy were uploaded into Veritas Health Innovation (Covidence, Melbourne, VIC, Australia) for screening, and duplicates detected were removed.

Study selection

Titles and abstracts of the retrieved studies were reviewed against the eligibility criteria by 2 independent reviewers. For remaining studies, the full-text articles were retrieved and assessed for eligibility by 2 independent reviewers. The reason for articles being excluded was determined by the first ineligible criterion from the following list: study design, population, intervention, and outcomes. Any discrepancies between reviewers regarding the eligibility of studies were resolved by the decision a third independent reviewer, and this process was used throughout the entirety of the review.

Quality assessment

The methodological quality of the eligible studies was assessed using the Academy of Nutrition and Dietetics Quality Criteria Checklist for Primary Research.[55] The criteria enable the assignment of a quality rating based on the responses from the 10 validity questions, which were designed to retrieve information to evaluate study design and execution. The final rating assigned to the eligible studies was positive (the highest quality rating: answered "yes" to ≥ 6 validity questions, including all 4 priority questions), negative (the lowest quality rating: answered "no" to ≥ 6 validity questions), or neutral (answered "no" to ≥ 1 of the 4 priority criteria questions).[55] Quality assessment of the eligible studies was completed by 2 independent reviewers. Overall, there was 92% agreement between the reviewers for the quality assessment of the studies.

Data extraction

A data extraction tool was developed, reviewed, and pilot tested by the research team. Data extracted included the study design, sample size, study setting, participant characteristics, intervention(s) and control groups, outcome measures, results, and conclusions. Data extraction from the included studies was completed by the first author and was checked by a second reviewer for accuracy and uniformity, and amendments were made where necessary.

Data synthesis

Data from the included studies could not be pooled for meta-analysis because there was significant heterogeneity in the methodological design of the studies. Therefore, a narrative synthesis of the findings of the included studies is presented and was guided by the Synthesis Without Meta-analysis in systematic reviews: reporting guideline.[56] Standalone culinary nutrition-education interventions were analyzed separately.

RESULTS

A total of 6951 articles (excluding duplicates, $n = 7$) were assessed against the eligibility criteria (Figure 1). After assessing the full texts of the articles, a total of 31 studies were included in the review, which included 1 study[57] that was only identified from the reference list of a previous systematic review.[46] Thirteen studies[57–69] evaluated a standalone culinary education intervention.

Description of the studies

Overall included studies. A detailed description of each the 31 included studies is provided in Table S8 in the

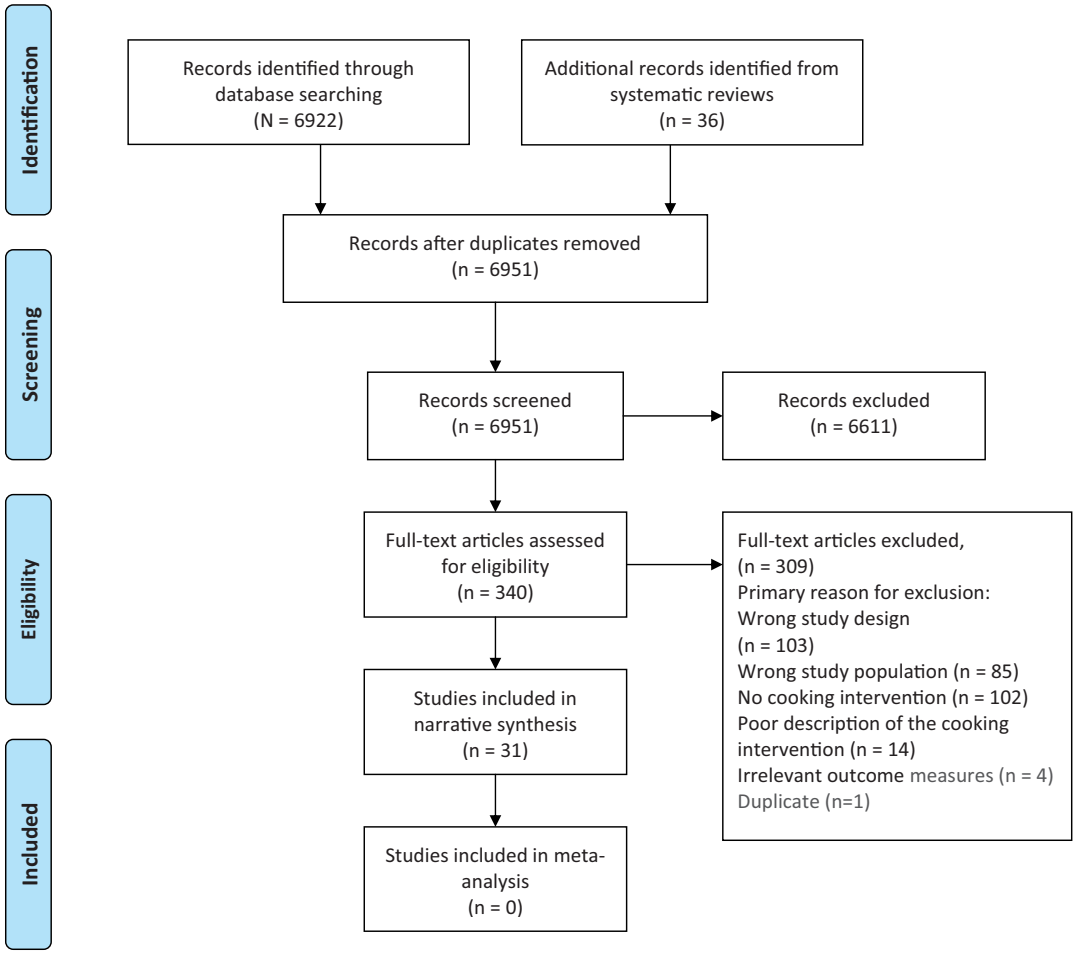

Figure 1 **Flow diagram for the selection of included studies, which followed thePreferred Reporting Items for Systematic Reviews and Meta-Analysis statement.**[49]

Supporting Information online. Table 2 summarizes the key characteristics of these studies. Study designs included RCTs (n = 12),[57,59,70–79] 2-group pre and post-test studies (n = 9),[60,61,63,65,66,68,80–82] single-group pre- and post-test studies (n = 9),[58,62,64,67,69,83–86] and 1 mixed-methods study.[87] The publication dates ranged from 2003[69] to 2019.[59,63] Studies were conducted in high-income countries (n = 20),[58–60,62,64,67–78,84–86] middle-income countries (n = 8),[57,63,66,79–82,87] and low-income countries (n = 3).[61,65,83]

Standalone culinary nutrition-education interventions. The study design of the standalone culinary education studies were RCT (n = 2),[57,59] 2-group pre- and post-test (n = 6),[60,61,63,65,66,68] and single-group pre- and post-test (n = 5).[58,62,64,67,69] The publication date of the studies ranged from 2003[69] to 2019.[59,63] The setting of the studies included high-income countries (n = 8),[58–60,62,64,67–69] middle-income countries (n = 3),[57,63,66] and low-income countries (n = 2).[61,65]

Description of the study population

Overall included studies. The recruited population of the studies comprised pregnant women (n = 6),[68,69,72–74,86] women ≤ 5 years postpartum (n = 12),[61,63,65–67,77,78,80,81,83,85,87] and parents or caregivers with children ≤ 5 years (n = 13).[57–60,62,64,70,71,75,76,79,82,84] No studies recruited women during the preconception period. Studies in which the population of interest was pregnant women predominately (n = 4) recruited participants at < 20 weeks' gestation. Three studies recruited subpopulation groups, including pregnant adolescents (16–18 years),[69] pregnant women with overweight and obesity,[74] and women who had been diagnosed with gestational diabetes in their most recent pregnancy.[77] Postpartum studies recruited women/parents/caregivers of infants (age < 24 months; n = 17)[57,59–63,65,66,70,71,79–84,87] and/or toddlers (age ≥24 and < 36 months; n = 6),[60,62,76,82,83,87] and/or preschoolers (age ≥36 but < 60 months; n = 10).[58,62,64,67,71,75,76,82,84,87] Study participants were recruited from health clinics (n = 13),[59,66–70,72–74,77,

Table 2 **Characteristics of studies included in the systematic review**

Reference, country	Country (OCED category)	Study quality rating	Study aim	Study design	Recruitment setting	Characteristics of the sample
Beinert et al. (2017)[70]	Norway (1)	Nt	To examine the long-term effect on toddlers' dietary intake and skepticism for new food in a 2-day intervention on how to prepare homemade food for toddlers	RCT	4 health care clinics, representing different socioeconomic areas, in Kristiansand, Norway	Parents with a 4–6 month-old infant
Fahmida et al. (2015)[80]	Indonesia (3)	P	To assess the effectiveness of promoting optimized complementary feeding recommendations for improving maternal knowledge, feeding practices, and child nutrient intake	2-group pre- and post- test	Children were identified through a list of Growth Monitoring Post (Posyandu) and confirmed by voluntary health workers (cadres).	A child between 9 and 16 months of age inclusive who was currently breastfeeding
Fletcher et al. (2013)[71]	Australia (1)	P	To assess the effectiveness of a telephone-based intervention in reducing child consumption of noncore foods	RCT	Preschools within 4 local government areas of the Hunter region of New South Wales, Australia	Parents with children aged 3–5 years who resided with them for $\geq$4 days/week and prepared most of their meals
Garcia et al. (2013)[58]	United Kingdom (1)	Nt	To evaluate the effectiveness of a cooking program on self-reported confidence about cooking skills and food consumption patterns in parents of young children	Single-group pre- and post-test	Informal "meet and greet" sessions held by community food workers at target nurseries targeting vulnerable families	Parents or caregivers with nursery age children
Gesell et al. (2015)[72]	United States (1)	P	To evaluate a prenatal behavioral intervention in a sample of low-income, predominantly Latina women	RCT (pilot study)	Women were predominately recruited from health care clinic waiting rooms.	Women $>$10 and $<$28 weeks pregnant, $\geq$16 years old, and in prenatal care
Helle et al. (2019)[59]	Norway (1)	P	To evaluate the effects of an e-health intervention on parental feeding practices and infant eating behaviors	RCT	Facebook advertisement on the University of Agder page and Norwegian municipalities' child health clinics	Parents with an infant aged 3–5 months and primarily responsible for preparing their infant's meals
Hillesund et al. (2016)[73]	Norway (1)	P	To investigate whether a lifestyle intervention during pregnancy optimizes pregnancy weight gain and affects maternal and birth outcomes	RCT	Recruited by midwives from 8 health care clinics in southern Norway	Nulliparous women with prepregnancy BMI $\geq$19 kg/m^2, were nondiabetic, $<$20 weeks pregnant, and carrying a single fetus

(continued)

Table 2 **Continued**

Reference, country	Country (OCED category)	Study quality rating	Study aim	Study design	Recruitment setting	Characteristics of the sample
Horodynski et al. (2004)[60]	United States (1)	Nt	To evaluate the effectiveness of the Nutrition Education Aimed at Toddlers program caregivers' knowledge, attitudes, mealtime practices, and dietary intake	2-group pre- and post-test (pilot study)	Families involved in the Early Head Start program, which provides services to low-income pregnant women and families	Toddlers aged 12–36 months, attending the Early Head Start program with a family income $\geq$ 100% poverty level
Hotz et al. (2005)[61]	Malawi (1)	Nt	To introduce practices for improving infant complementary feeding and evaluate their adoption and impact on infant dietary intake	2-group pre- and post-test (pilot study)	Women and their children from Nailuwa, Nduta, and Ntandiwa Maduwani, Central African villages	Women with children aged 9–23 months of age currently breastfeeding
Islam et al. (2013)[82]	Bangladesh (3)	Ng	To measure the impact of a hygiene intervention on the contamination of weaning food for infants	2-group pre- and post-test	Households in Matlab, a subdistrict and a rural area of Bangladesh	Households with children aged 6–18 months
Izumi et al. (2016)[62]	United States (1)	Nt	To evaluate the feasibility of a cooking intervention to improve parent confidence in cooking vegetables and to encourage families to taste and learn to like eating vegetables	Single-group pre- and post-test (pilot study)	Families participating in Early Head Start Home Visiting program, Portland, Oregon	Parents with children aged 0–3 years and enrolled in the Early Head Start Home Visiting program
Kartasurya et al. (2019)[63]	Indonesia (3)	Ng	To evaluate the impact of a complementary feeding program on the nutritional status of children	2-group pre- and post-test	Children were identified through a list of Growth Monitoring Post (Posyandu) in 2 Indonesian neighborhoods.	Mothers with children $>$ 2 years of age
Kim et al. (2016)[64]	United States (1)	Ng	To evaluate the effectiveness of Little Books and Little Cooks program on parent and child dietary intake, parent-child interactions, child cooking skills, parent feeding styles, and child eating behaviors.	Single-group pre- and post-test	Community recreation centers, libraries, and parent centers	Caregivers and children aged 3–5 years
Lewkowitz et al. (2018)[74]	United States (1)	Nt	To evaluate the effectiveness of a home-based lifestyle intervention on initiation rates in a socioeconomically disadvantaged population	RCT	Single university-based tertiary care institution, St. Louis, Missouri	Black women (aged 18–45 years) who had delivered a live-born neonate within 6–12 months before data collection related to breastfeeding

(continued)

Table 2 **Continued**

Reference, country	Country (OCED category)	Study quality rating	Study aim	Study design	Recruitment setting	Characteristics of the sample
Lhussier et al. (2012)[88]	Pakistan (3)	Nt	Describe the development of a nutrition intervention program	Mixed-methods design	Advertised locally, through word of mouth, and hospital referrals in northwest Pakistan	Mothers with infants <3 years of age
Magnin et al. (2018)[84]	Madagascar (4)	Nt	To evaluate a comprehensive treatment program for infant malnutrition using a qualitative approach	Single-group pre- and post-test	Community centers	Children aged 6–59 months with a WHZ between -2 and -3
McSweeney et al. (2017)[75]	United Kingdom (1)	Nt	To determine which methods, tasks, and activities were acceptable to preschool teachers, practitioners, and families	RCT (pilot study)	4 preschool centers, North East England	Families with a child aged 3–4 years attending a local government preschool center
Mulualem et al. (2016)[65]	Ethiopia (4)	Nt	To assess the effects of nutrition education in promoting pulses for complementary food	2-group pre- and post-test	2 districts of Ethiopia	Mothers with healthy children aged 6–18 months
Natale et al. (2016)[76]	United States (1)	Nt	To assess the impact of Healthy Caregivers–Healthy Children intervention on dietary patterns and BMI percentile over 2 school years	RCT	Childcare centers in Miami-Dade County, south Florida	Low-income families with children aged 2–5 years
O'Reilly et al. (2016)[77]	Australia (1)	P	To evaluated the effectiveness of a lifestyle modification program in mothers with prior GDM within their first postnatal year	RCT	Australian antenatal clinics, mail-out via the NDSS, referrals from a private obstetrician and hospital records database	Women aged $\geq$18 years with a diagnosis of GDM in their most recent pregnancy
Ostbye et al. (2009)[78]	United States (1)	P	To analyze the impact of the Active Mothers Postpartum intervention on dietary intake, physical activity levels, and body weight of postpartum women	RCT	3 obstetrics clinics in North Carolina and recruitment posters placed in community centers and obstetrics clinics	Women 6 weeks postpartum with a BMI $\geq$25 kg/m^2
Pathirana et al. (2018)[85]	Australia (1)	Nt	To evaluate the impact of the Have Fun Be Healthy intervention on health behaviors of children and self-efficacy of parents and caregivers	Single-group pre- and post-test study	Playgroups, Queensland, Australia	Parents and caregivers with children aged <5 years from socioeconomically disadvantaged backgrounds
Roche et al. (2017)[66]	Ecuador (2)	Nt	To evaluate the effectiveness of a community-based intervention to improve diet and growth and in children	2-group pre- and post-test	Identified through birth registries, community lists, midwives, and community leaders	Mothers and their children aged <2 years

(continued)

Table 2 **Continued**

Reference, country	Country (OCED category)	Study quality rating	Study aim	Study design	Recruitment setting	Characteristics of the sample
Rosal et al., (2011)[86]	United States (1)	P	To pilot test the Diabetes Prevention Program lifestyle intervention among diverse, low-income, postpartum women	Single-group pre- and post-test (pilot study)	Women enrolled in the Women-Infant-Children program	Postpartum women with BMI $>$ 27 kg/m^2
Ruel et al. (2008)[79]	Haiti (3)	Nt	To compare the effect on child growth of a preventive and a recuperative nutrition program	RCT	Community mothers club	Women with children aged 6–59 months
Salehi et al. (2004)[83]	Iran (2)	Ng	To assess the impact of nutrition education on growth indices of Iranian nomadic children	2-group pre- and post-test	A group of randomly selected Qashqa'i tribe families	Families in 48 subtribes of the Qashqa'i with children aged 0–59 months
Sharma et al. (2018)[87]	United States (1)	Nt	To assess the Healthy Eating Active Living program on participant diet, physical activity, and breastfeeding self-efficacy and intentions	Single-group pre- and post-test (pilot study)	University of Texas Physicians health care system	Pregnant women-$<$ 28 weeks gestation, and a Medicaid participant or Medicaid eligible
Ugalde et al. (2017)[67]	United States (1)	Ng	To assess the feasibility of a Mommio's in-game recipe box for improving child vegetable consumption	Single-group pre- and post-test (pilot study)	Participants from the previous Mommio game study, research volunteer list, and social media posts	Mothers with children aged 3–5 years who reported difficulty in getting their children to eat vegetables
Waswa et al. (2015)[57]	Kenya (3)	Nt	To assess the effect of nutrition education for caregivers on the diversity of children's complementary diets and nutrition knowledge of caregivers	RCT	Households residing in 30 villages of Kenya	Caregivers with children aged 6–17 months
Watt et al. (2015)[68]	United States (1)	Nt	To evaluate a primary care–based nutrition intervention for pregnant women on maternal diet, exercise, stress, depression, social support, and infant feeding practices	2-group pre- and post-test (pilot study)	Primary care clinics that serve a low-income, Hispanic population in the southwestern United States	Pregnant women aged $\geq$18 years
Wrieden et al. (2003)[69]	United Kingdom (1)	Nt	To evaluate the impact of a nutrition education program, led by midwives, for teenage pregnant women on dietary intake and cooking skills	Single-group pre- and post-test (pilot study)	Ninewells Hospital, Dundee, or Perth Royal Infirmary, Scotland	Women aged 16–18 years presenting with their first pregnancy

Abbreviations: BMI, body mass index; GDM, gestational diabetes mellitus; NDSS, National Diabetes Services Scheme; Ng, negative rating; Nt, neutral rating; OCED, Organization for Economic Cooperation and Development; P, positive; RCT, randomized controlled trial; WHZ, weight-to-height *z*-score.

[78,86,87] by area of residence (eg, village, district, subtribe; n = 6),[57,61,63,81,82] through government-funded women and children's health programs (n = 3),[60,62,85] childcare and preschools (n = 4),[58,71,75,76] social media (n = 2),[59,67] data registries or lists (n = 3),[66,67,80] and community centers (n = 2).[64,83]

Standalone culinary nutrition-education interventions. The recruited population of the 13 studies were pregnant women (n = 2),[68,69] women ≤ 5 years postpartum (n = 5),[61,63,65–67] and parents or caregivers with children ≤ 5 years (n = 6).[57–60,62,64] Pregnant women were recruited during the first trimester[68] or at any gestational stage.[69] Study participants were recruited from health clinics (n = 5),[59,66–69] area of residence (eg, village, district, subtribe; n = 4),[57,61,63,65] government-funded women and children's health program (n = 2),[60,62] preschools (n = 2),[58,75] social media (n = 2),[59,67] data registries or lists (n = 3),[66,67] and community centers (n = 1).[68]

Description of the study interventions

Overall included studies. Half the studies (n = 15) provided hands-on practical experience in the culinary education intervention.[58,60–62,65–67,69,70,73–75,80,81] In 5 studies,[57,59,63,83,87] the intervention was limited to observations of food preparation or cooking demonstrations rather than a hands-on practical experience by the participants. Eight studies[64,68,72,73,76–78,84] did not indicate the method of delivery of the culinary education intervention. The most commonly used frameworks for designing the study intervention were social cognitive theory[75,76,78,85,86] and the Social-Ecological Model.[71,85] The duration of a study intervention ranged from 3 to 5 minutes for online cooking videos[59] to a 4-hour session.[70] Fourteen studies[63–65,67,69,71,73–75,80–83,87] did not specify the duration of the intervention. The frequency of the study intervention ranged from weekly to monthly, and some interventions were provided in intense, short bursts ranging from 2 to 12 consecutive days.[66,70] Eight studies[60,61,67,78,79,81,82,87] did not specify the frequency of the study intervention. The duration of study interventions was 0 to < 6 months (n = 10),[58,63–65,70–72,75,81,84] ≥6 to < 12 months (n = 5),[59,62,73,78,80] and ≥12 months to ≤ 24 months (n = 5).[68,76,77,79,82] Four studies[68,77,79,82] did not indicate intervention duration. In summary, the study interventionists were volunteers, graduate (Masters and PhD) students, graduates (nutrition, sports science), home-economics teachers, preschool staff, community health workers, dietitians, physiotherapists, doctors, midwives, and prenatal clinic staff. The study interventionist was reported in 28 studies.[57,58,60–63,65,66,68–72,74,75,77–87] Fifteen studies[57,61–63,66,68,69,72,73,75,82,83,85–87] described the training of the interventionist.

Standalone culinary nutrition-education interventions. Hands-on practical experience in the culinary education intervention was provided in 8 studies.[58,60–62,65–67,69] In 3 studies,[57,59,63] the intervention was limited to observations of food preparation or cooking demonstrations rather than a hands-on practical experience by the participants. Two studies[64,68] did not indicate the method of delivery for the culinary education intervention. The duration of a study intervention ranged from 3 to 5 minutes for online cooking videos[59] to a 90-minute session.[62,68] Five studies[63–65,67,69] did not specify the duration of the intervention. The frequency of the study intervention ranged from weekly to monthly and some interventions were provided in intense, short bursts including 12 consecutive days.[66] Three studies[60,61,67] did not specify the frequency of the study intervention. The duration of study interventions was 0 to < 6 months (n = 6),[57,58,63–66] ≥6 to < 12 months (n = 3),[59,62,69] and ≥12 months to ≤ 24 months (n = 1).[68] Three studies[60,61,67] did not specify the duration of the study intervention. Study interventionists were volunteers, graduates (nutrition, sports science), community health workers, midwives, a nutritionist, and prenatal clinic staff. The study interventionist was reported in 10 studies.[57,58,60–63,65,66,68,69] Seven studies[57,61–63,66,68,69] described the training of the interventionists.

Quality assessment

Assessment of the methodological quality of studies resulted in 8 studies[59,71–73,77,78,80,85] with a positive rating, 16 studies[57,58,60–62,65,66,68–70,75,76,79,83,84,86,87] with a neutral rating, and 7 studies[63,64,67,81,82] received a negative rating (summarized in Table S9 in the Supporting Information online). Quality assessment of the 13 standalone culinary nutrition-education intervention studies indicated that 1 study[59] had a positive rating, 8 studies[57,58,60–62,65,66,68,69] received a neutral rating, and 4 studies[63–65,67] had a negative rating. On the basis of the responses to 10 validity questions, a negative rating was commonly attributed to unclear inclusion and exclusion criteria, poor description of the study intervention, outcome assessment methods of poor validity, unclear methods of handling withdrawals, a lack of blinding, and inappropriate statistical analysis methods. "Not applicable" responses were commonly assigned to questions related to comparability of study groups and blinding of participants, interventionists, and outcome assessors for single-group pre- and post-test studies and did not contribute to the awarded quality rating.

Table 3 **Summary of study outcomes by participant group, intervention type, and study quality**

Outcome	Study (reference number)[a]							
	Pregnant women		Postpartum					
			Women		Parents/caregivers		Children	
	Standalone culinary intervention	Intervention with culinary component	Standalone culinary intervention	Intervention with culinary component	Standalone culinary intervention	Intervention with culinary component	Standalone culinary intervention	Intervention with culinary component
Parental food and cooking skills		**(87)**	**(65)**		**(62)**, **(58)**, **(64)**		n/a	n/a
Parental nutrition knowledge		(87)	(61), **(63)**, **(65)**	(88), **(80)**, (84)	**(58)**, **(57)**[b], (81)	**(83)**	n/a	n/a
Diet quality								
Nutrient intake	**(68)**			(77)[b], **(78)**[b]			**(61)**, **(66)**	(75), **(80)**, (83)
Food-group consumption	**(68)**, (69)	**(73, 87)**[b]		(78)	**(58)**, **(64)**, (81)		(59)[b], **(64)**, **(66)**, **(57)**[b], (81)	**(70)**[b], (71)[b], (85), (80), **(83)**
Infant feeding			(61), **(63)**, **(65)**, (68)	**(74)**[b], **(82)**, (84), **(87)**	**(57)**[b], (59)[b], (81)			
Eating behavior				(86)	**(64)**	(85)	**(59)**[b], **(64)**	(70)[b]
Health outcome								
Anthropometry	(68)	**(72)**[b]		(77)[b], (78)[b], **(86)**			(59), **(63)**, **(65)**, **(66)**, (68)	**(79)**[b], **(83)**, (84), (75), **(76)**[b]
Mental health	**(68)**			(77), **(86)**			**(68)**	
Clinical indicators				**(77)**[b]				

Abbreviation: n/a, not applicable.
[a]Reference numbers in bold indicate a significant improvement ($P < 0.05$) was reported.
[b]Randomized controlled trial.

Description of study outcomes

Outcome measures reported in the included studies were parental food and cooking skills (n = 5 studies), nutrition knowledge (n = 11), parent and child diet quality (n = 25), and health outcomes (n = 14); results are provided in Table 3. Fourteen studies[58–60,63,66,68,70,71,76,78–80,82,85] assessed outcomes measures beyond the immediate postintervention assessment period. The length of follow-up for outcome measures ranged from months to years. Seven studies[59–61,67,74,80,86,87] only assessed outcome measures postintervention rather than at baseline and follow-up.

Outcome 1: parental food and cooking skills. Five studies[58,62,64,65,86] analyzed the impact of culinary nutrition-education interventions on cooking frequency, confidence, skills, and interactions in pregnant women (n = 1 study), postpartum women (n = 1 study), and postpartum parents (n = 3 studies). Cooking outcomes were measured by interviews with women,[65] observation checklist[64] and questionnaires.[58,62,86] All 5 studies (2-group pre- and post-test study, n = 1); single-group pre- and post-test studies, n = 4),[58,62,64,65,86] which were all standalone culinary nutrition-education interventions, reported a significant improvement in cooking frequency, confidence, skills, and interactions. Three studies[58,62,86] reported a significant increase in the proportion of pregnant women and parents in the intervention group who felt confident in cooking from basic ingredients and preparing new foods and vegetables at follow-up. Two studies[64,65] reported a significant improvement in cooking skills of postpartum women and parents in the intervention group at follow-up.

Outcome 2: parental nutrition knowledge. Eleven studies[57,58,60,61,63,65,80,82,83,86,87]analyzed the affect of culinary nutrition-education interventions on food and nutrition knowledge and attitudes in pregnant women (n = 1 study), postpartum women (n = 6 studies), and postpartum parents (n = 4 studies). Food and nutrition knowledge and attitudes were measured by questionnaires,[58,60,86] interviews with mothers and caregivers,[57,63,65] or self-reported in focus groups.[83,87] Six studies[57,58,63,65,80,82] (RCT, n = 1; 2-group pre- and post-test studies, n = 4; and single-group pre- and post-test study, n = 1), including 4 standalone culinary nutrition-education interventions, reported a significant improvement in food and nutrition knowledge and attitudes. Three studies reported a statistically significant difference in the intervention compared with the control group on food and nutrition knowledge of postpartum mothers and caregivers, with greater knowledge related to nutrient functions, food sources, and consequences of nutrient deficiencies related to the intake of iron, zinc, and calcium after the intervention ($P \leq 0.001$)[80] and improved general nutrition knowledge after the intervention ($P < 0.05$).[57,65,82] Three studies reported a significant improvement in food and nutrition attitudes of mothers and parents in the intervention compared with the control group at follow-up ($P < 0.05$).[63,65,82]

Outcome 3: parent and child diet quality. Nutrient intake and consumption of food groups. Nineteen studies[57–61,64,66,68–71,73,75,77,78,80,82,84,86] analyzed the impact of culinary nutrition-education interventions on dietary intake, including nutrient intake and diet quality in pregnant women (n = 4 studies), postpartum women (n = 2 studies), postpartum parents (n = 3 studies), and/or children ≤5 years of age (n = 12 studies). Dietary intake was measured by a diet-behavior lifestyle survey,[86] 4-day food diary,[75] 24-hour recalls,[57,60,61,66,69,78,80,82] brief food frequency questionnaires[58,64,68] and food frequency questionnaires.[59,66,69–71,73,77,80,84,86] Ten studies (RCTs, n = 3; 2-group pre- and post-test studies, n = 4; and single-group pre- and post-test studies, n = 3), including 6 standalone culinary nutrition-education interventions, reported significant improvements in nutrient intake and/or food-group consumption.[57,58,61,64,66,68,70,73,80,86] In malnourished children aged 0 to 24 months, 3 studies reported higher daily mean intake for energy (mean differences ± standard deviation: 178 ± 144 kcal for infants aged 6–12 months, $P < 0.05$; 294 ± 153 kcal for children aged 12–18 months, $P < 0.05$) at 6-month follow-up[66] and higher energy, protein, iron, zinc, calcium, and niacin intakes ($P \leq 0.05$) after the intervention.[61,80] Six studies[58,64,66,68,73,86] reported greater consumption or greater intention to consume fruit and vegetables by pregnant women, parents, and children.

Infant feeding. The impact of culinary education interventions on infant feeding outcomes, such as on breastfeeding rates, frequency, initiation, duration, long-term infant feeding plans, and complementary feeding practices, was analyzed in 11 studies.[57,59–61,63,65,68,74,81,83,86] Infant feeding was measured by self-report by a focus group,[83] laboratory analysis of food samples,[83] participant-completed surveys or questionnaires,[61,74,86] interview with mothers,[63] and questionnaires.[59,60] Six studies (RCT, n = 2; 2-group pre- and post-test studies, n = 3; and 1 single-group pre- and post-test study)[57,63,65,74,81,86] including 2 standalone culinary nutrition-education interventions, reported significant improvements in infant feeding. Two studies reported significantly higher mean infant-feeding practice scores by mothers in the intervention group compared with

those in the control group at follow-up ($P < 0.05$).[63,65] Significant improvements in food hygiene for complementary feeding practices were reported, with higher preparation sanitation scores by mothers (mean [SD], 6.9 [1.84] vs 6.1 [2.0]; $P = 0.04$)[63] and reduced fecal coliform and fecal streptococci counts in infant food samples ($P < 0.001$) in the intervention compared with the control group at follow-up.[81]

Eating behavior. Five studies[59,64,70,84,85] analyzed the impact of culinary nutrition-education interventions on eating behavior of postpartum women (n = 1 study), postpartum parents (n = 2 studies), and children (n = 3 studies). Eating behavior was measured by questionnaires.[59,64,70,84,85] Four studies (RCTs, n = 1; single-group pre- and post-test studies, n = 3),[59,64,84,85] including 2 standalone culinary nutrition-education interventions, reported a significant improvement in eating behavior. Two studies[59,64] reported significant improvements in the eating behavior of parents and children across multiple domains, and 1 study[84] reported a significant improvements in parental and carer self-efficacy in promoting healthy eating for their children ($P < 0.05$).

Outcome 4: parent and child health outcomes. Anthropometry: gestational weight gain. Two studies (RCT, n = 1; 2-group pre- and post-test study, n = 1)[68,72] analyzed the impact of culinary nutrition-education interventions on gestational weight gain of pregnant women. Outcomes measured included prepregnancy BMI,[72] weight gain during pregnancy,[68,72] and adherence to the Institute of Medicine gestational weight gain guidelines.[68,72] One study (an RCT), which was an intervention with a culinary nutrition-education component, reported that significantly fewer women in the intervention group with a BMI in the healthy weight range exceeded the Institute of Medicine gestational weight gain guidelines after the intervention ($P = 0.04$).[72]

Anthropometry: postpartum women. Three studies (RCTs, n = 2; and 1 single-group pre- and post-test)[77,78,85] analyzed the impact of culinary nutrition-education interventions on anthropometry of postpartum women. Anthropometry was measured by weight,[77,78,85] waist circumference,[77] change in weight,[85] percentage change in weight,[85] and BMI.[85] One study (a single-group pre- and post-test study), which was a standalone culinary nutrition-education intervention, reported significant weight loss in participants at the 4-month follow-up (intervention % weight loss [SD], −2.7 [4.4] lb [−1.2 kg (2.0 kg)]; $P = 0.04$).[85]

Anthropometry: children. Ten studies[59,63,65,66,68,75,76,79,82,83] analyzed the impact of culinary nutrition-education interventions for mothers and parents on their child's anthropometry. Outcome measures included weight,[59,63,65,66,76,79] length/height,[59,63,65,66,79] weight for age,[59,63,66,68,79] BMI for age,[59,76] height/length for age,[66,79] and mid-upper arm circumference.[65] Six studies (RCTs, n = 2; 2-group pre- and post-test studies, n = 4), including 2 standalone culinary nutrition-education interventions, reported a statistically significant difference in the intervention compared with the control group for the anthropometry of malnourished children aged 0–5 years, with greater weight gain[63,65,66] and weight for age *z*-scores,[63,65,66,79,82] height for age,[79,82] weight for height,[79,82] and mid-upper arm circumference,[82] and a smaller increase in BMI percentile ($P = 0.04$)[76] after the intervention and up to 6 months' follow-up.

Mental health and development. Three studies[68,77,85] analyzed the impact of culinary nutrition-education interventions on mental health outcomes, including depression, stress, and cognitive function in pregnant women (n = 1 study), postpartum women (n = 2 studies), and children (n = 1 study). Mental health outcomes were measured by surveys.[68,77,86] Two studies (single-group pre- and post-test study, n = 1; and 2-group pre- and post-test study, n = 1)[68,85] including 1 standalone culinary nutrition intervention, reported improved mental health outcomes. Watt et al[68] reported a significant reduction in the proportion of pregnant women who screened positive for depression in the intervention group (23% vs 7%; $P \leq 0.05$) and a reduction in stress levels in both the intervention and control groups ($P \leq 0.05$) from the first to the third trimester. In postpartum women, Rosal et al[85] reported a statistically significant reduction (improvement) in Edinburgh postnatal depression scale scores (mean change [standard deviation]: −2.3 [5.5]; $P = 0.03$) and perceived stress scale scores (mean change: −3.1 [3.2]; $P = 0.02$) in the intervention group from baseline to 4 months' follow-up. Watt et al[68] reported a significantly higher percentage of infants in the intervention group compared with the control group received a pass rating for their mental development based on the Ages and Stages Developmental Screen (Percentage (n=): 80% (16) vs 52% (11); $P \leq 0.10$) at 12 months' follow-up.

Clinical indicators. One standalone culinary nutrition intervention study (an RCT)[77] analyzed the impact of culinary nutrition-education interventions on clinical indicators in postpartum women. O'Reilly et al[77] reported a significant reduction in the intervention

group for total cholesterol ($P < 0.001$), LDL-C ($P < 0.001$), and HDL-C ($P < 0.001$) levels, whereas fasting blood glucose levels significantly increased ($P < 0.001$) from baseline to 12 months' follow-up.

DISCUSSION

This review provides evidence that interventions with a culinary nutrition-education component can improve parental food and cooking skills, nutrition knowledge, parent and child diet quality, and health outcomes. Because of the number of RCTs that reported significant findings, there is slightly more convincing evidence that culinary nutrition-education interventions are positively associated with nutrient intake and consumption of food groups, eating behaviors, and child anthropometry. Meta-analysis was not possible, because of significant heterogeneity of study designs and methodologies used in the included studies. For example, most studies (n = 18 of 31) included culinary nutrition education as an intervention component rather than as a standalone intervention, with variable outcome measures and assessment methods reported. Therefore, it was not possible to isolate the specific effects of the culinary nutrition-education component on the study outcomes for many of the included studies.

Life stages and culinary nutrition education

Culinary nutrition-education intervention studies were predominately (80%) conducted during the postpartum period and targeted nutrition issues in infants and young children. These studies primarily aimed to prevent infant and child malnutrition; therefore, the culinary nutrition-education intervention component focused on preparing protein-rich complementary foods using hygienic handling practices. These studies only reported diet quality and health outcomes (ie, anthropometry) of the infants and children and excluded the mother and parents. Therefore, more evidence is needed during the postpartum period, especially in developing countries, from analyses of the impact of dietary interventions including culinary nutrition education on nutrition and health outcomes of parents and children.

In this review, we identified that culinary nutrition-education interventions have not been recognized as a potential strategy to improve the diet quality of couples during the preconception period. Nutrition interventions are needed during this life stage; evidence indicates that most women from high-income countries during the preconception period do not meet country-specific national recommended daily intakes for the core food groups (ie, fruit, vegetables, grain-based food, dairy and alternatives, meat and alternatives), especially for vegetables and grain-based foods, and have inadequate micronutrients intake, including folate.[88–90] Furthermore, findings from animal studies also indicate that poor paternal diet quality is negatively associated with fertility, sperm quality, and offspring health.[91] The lack of research in this area may be due to the significant methodological challenges associated with conducting preconception studies. For example, worldwide it is estimated that 44% of pregnancies are unplanned[92–94]; therefore, there is a need to recruit both women and couples who are planning and not planning their pregnancies (ages 18–29 years). Adverse maternal and infant outcomes are associated with unplanned pregnancies; therefore, it is important that women and couples who are "at risk" of a pregnancy are recruited for research studies.[95,96] Couples who experience difficulties conceiving may be reluctant to join research studies because of concurrent stress, however. Some couples may be more willing to participate in interventions that may be beneficial for their fertility. Despite these challenges, evidence suggests that recruitment during the preconception period is feasible.[94,97] Therefore, culinary nutrition intervention studies that target women and couples during the preconception period to support development of culinary skills and healthy eating behaviors into pregnancy and beyond are lacking in the literature and warrant exploration.

Recruitment population of culinary nutrition-education interventions

We found that culinary nutrition-education studies specifically recruited women and often excluded their partners. However, findings from a qualitative study[98] of American, first-time pregnant couples (n = 11) indicated that fathers were more involved in preparing and cooking meals at home because their partner's pregnancy-related symptoms (eg, nausea and fatigue) hindered their capacity to engage in those activities. These findings suggest that the food choices of pregnant women are also influenced by their partners' food preparation and cooking skills and eating behaviors. Therefore, cooking interventions that do not include partners may be less effective in improving diet quality of couples during critical life stages such as pregnancy. This is important, given that younger men in particular have lower levels of confidence in food planning and cooking skills.[99] It is important that women receive adequate support with home cooking from their partners, because evidence indicates that pregnant women consume less fruit and vegetables and more energy-dense, nutrient-poor convenience foods to manage their pregnancy-related symptoms.[98,100,101] Findings from

the Australian Longitudinal Study on Women's Health indicated that pregnant women consumed 4.2 servings per day of discretionary foods (ie, energy-dense, nutrient-poor foods) on average, which is 60% higher than the recommended limit of 2.5 servings per day.[102] Therefore, to prevent poor dietary patterns during childbearing years and beyond, culinary nutrition-education interventions should consider recruiting couples to ensure that both partners have adequate culinary skills to support healthy eating behaviors. In the development of culinary nutrition interventions targeting the PPP life stages, the Cooking Education (Cook-Ed) Model is recommended for use to guide planning, implementation, and evaluation.[103]

Methodological design of the included studies

Studies included in this review were generally of moderate methodological quality and there was considerable variability in the study design. A third of the included studies did not include a control group. Of studies that did include a concurrent control group (n = 21 of 31), only 12 used randomization for group allocation. Furthermore, this review included pilot studies (n = 8 of 31) that were designed to measure feasibility and preliminary efficacy but were not powered to measure the intervention impact on primary outcomes. Many studies (n = 17 of 31) did not report how the facilitators of the intervention were trained, and the intensity (consecutive days to monthly), and duration (2 days to 18 months) of the intervention varied considerably. A significant proportion of studies (n = 9 of 31) used outcome assessment methods with poor validity. Half of the studies (n = 16 of 31) only evaluated the outcome measures immediately after the intervention and, therefore, the long-term impact of the intervention with a culinary nutrition-education component could not be assessed.

Implications for policy and practice

This review has identified potential benefits of culinary nutrition interventions during pregnancy and postpartum; thus, we recommend that maternal and family health service managers at national, state, and local levels consider dedicating resources to adapting and conducting trials of existing culinary nutrition programs or, as appropriate, developing new culinary nutrition programs, specific to these life stages. Culinary nutrition programs could be integrated into existing health education programs during pregnancy or postpartum or as standalone programs. Developing a workforce in maternal and family health services with culinary nutrition expertise would be needed to support such initiatives.

Furthermore, because this review adds to the existing evidence on the benefits of culinary nutrition and culinary medicine-education programs, it is recommended that those responsible for health and community infrastructure consider identifying and creating a register of existing kitchen facilities suitable for group culinary-education programs. This could include using an existing kitchen in a community or neighborhood center, or teaching kitchens that exist in many schools and technical colleges or some universities and hospitals. For new health and community infrastructure developments, we recommend inclusion of community facilities designed for hands-on culinary nutrition-education programs. Indeed, there are options for providing culinary nutrition education even when teaching kitchens are not available (eg, mobile kitchens or carts for purchase or hire). In addition, with advances in online education and telehealth, offering an online culinary nutrition-education intervention could be tested for feasibility and acceptability to the target group. Online programs may appeal to parents in the postpartum period, as may face-to-face programs with free or subsidized childcare available. For additional guidance regarding the development, implementation, and evaluation of culinary nutrition-education programs, readers are directed to the Cook-Ed model.[103]

Recommendations for future research

From the findings of this review, the following recommendations for research are proposed for culinary nutrition-education interventions during PPP:

1. Attempt to recruit women and their partners for culinary nutrition-education interventions during PPP.
2. Consider developing a modularized program starting at preconception and offering components through pregnancy and postpartum periods.
3. Ensure the program is delivered by an interventionist with expertise in culinary nutrition education and provide relevant training.
4. Provide culinary nutrition education that includes hands-on cooking experience, cooking demonstrations, and theoretical education for participants.
5. Evaluate culinary nutrition-education interventions using validated measurement and reporting tools.
6. Publish studies with positive and negative findings to contribute to the establishment of a robust evidence base. The Cook-Ed model provides guidance for researchers for developing, implementing, and evaluating high-quality research studies on culinary nutrition interventions.[103] It highlights the importance of

using a codesign process to guide program development.

7. To increase the efficacy of culinary nutrition-education interventions on parental and child health outcomes, programs need to be integrated into practice over the long term at local, state, and national levels. There is potential for the incorporation of culinary nutrition education in clinical settings, including maternal and child health care services, as well the community setting (eg, health care clinics, childcare).

CONCLUSION

The findings from this systematic review indicate interventions with a culinary nutrition-education component can improve parental food and cooking skills and nutrition knowledge, and indicators of parent and child diet quality and health outcomes. More evidence is needed from high-quality studies, particularly adequately powered RCTs, in which culinary nutrition education is the primary focus of the intervention, rather than a subsidiary component, to determine the optimum content and format for intervention delivery for maximum impact on intervention outcomes. There are opportunities to create an evidence base on culinary nutrition-education interventions in the preconception period starting with feasibility studies. The existing evidence base for culinary nutrition-education interventions in pregnancy and postpartum has excluded partners to date, and this is an area recommended for additional research. Future studies should identify intervention elements needed, including optimal social support to promote sustainable healthy eating behaviors for the prevention of overweight and obesity.

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Supporting Information

The following Supporting Information is available through the online version of this article at the publisher's website.

Table S1 **Search strategy protocol submitted to PROSPERO October 2019**

Table S2 **Search strategy results from databases**

Table S3 **Key word search strategy for MEDLINE**

Table S4 **Key word search strategy for EMBASE**

Table S5 **Key word search strategy for CINAHL**

Table S6 **Key word search strategy for Cochrane Library**

Table S7 **Key word search strategy for databases**

Table S8 **Summary of intervention, outcomes, and key findings from the included studies of the systematic review**

Table S9 **Summary of the quality assessment for the included studies**

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