

Determining best practice for school-based nutrition and cooking education programs: A scoping review

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Established healthy eating behaviours in childhood underpin the development of similar patterns into adulthood. School-based nutrition and cooking programs have been found to enhance nutrition and cooking knowledge and cooking self-efficacy. This scoping review examined the literature about the effectiveness of nutrition education programs conducted within the school setting. Databases were searched to identify relevant studies focused on primary school nutrition education and cooking programs. The evidence was assessed specifically in relation to how an effective program is reflected in the *Health Promoting Schools Framework*. Six articles met the inclusion criteria. Three programs cross-integrated with other school subjects. All programs used hands-on activities, and half incorporated gardening and included excursions to farms or markets. All programs highlighted the need for community and parental engagement. A cross-curricular approach can have a profound effect on improving dietary intakes, food and nutrition knowledge, and behaviours. Collaboration between teachers and nutrition educators is instrumental in delivering a successful program. Addressing the components of the *Health Promoting Schools Framework* in the development of a nutrition education and cooking program is integral to promote its successful implementation.

Introduction

Concurrent with the increasing prevalence of obesity in school aged children (Australian Bureau of Statistics, 2018; United Nations Children's Fund, 2019; World Health Organisation, 2019) is the decrease in cooking at home and the consequent decline in valuable cooking skills (Begley, 2016). Underpinning these changes is an increase in the consumption of readily available energy-dense and nutrient-poor foods, and a parallel inability for children to meet recommended intakes of fruit and vegetables (Australian Institute of Health and Welfare, 2020; van der Bend et al., 2017).

It is well recognised that establishing healthy eating behaviours early in childhood is a foundation for similar patterns of eating into adulthood, thus supporting generational healthy adult development (Birch, 1979). A key nutritionally sensitive stage in the life-course, providing nutrition interventions during childhood can potentially promote the

attainment of optimal nutrition, and ideal physical and mental development before the next stage of rapid adolescent growth (World Health Organisation, 2019).

The school setting is an opportune environment to promote healthy eating habits and to develop a culinary skill base in children, for use at home and in the future. Research demonstrates that school-based nutrition and cooking education programs enhanced nutrition, cooking knowledge and cooking self-efficacy and allowed for the development of healthy relationships with food (Allirot et al., 2016; Cunningham-Sabo & Lohse, 2013; Lovrics, 2019; Zahr & Sibeko, 2017). Similarly, research has found children involved in meal preparation at home were more likely to have a higher Diet Quality Index, eat more serves of vegetables and fruit per day compared with children who never helped, and have a greater variety of food intake across all food groups (Chu et al., 2014).

However, there are many iterations of nutrition and cooking education programs across many different settings, and age groups. The aim of this scoping review was to assess the effectiveness of nutrition education programs in the school setting. The research evidence related to primary and secondary school (Kindergarten to Year 12) nutrition education programs with a cooking component was examined specific to changes in nutrition and cooking knowledge and behaviours, and culinary skills, and considered how aspects of the WHO's *Health Promoting Schools Framework* (HPSF) (World Health Organisation, 2022) is incorporated into various programs. The influence of social and environmental factors on children's food choices has introduced a need to consider the overall school community environment when promoting health and wellbeing to students. To address such considerations, a whole-school approach, embodied by the HPSF model, is increasingly being endorsed as an effective way to promote nutrition and health in the school setting. A whole-school approach recognises that learning and health are linked, and that all aspects of the school and its internal and external community, can impact upon students' health and wellbeing (Rowe et al., 2010). The school and its surrounding community engage to implement policies, practices, and other measures that are culturally appropriate, provide opportunities for growth and success, and strive to improve the health of school personnel, families, and community members, in addition to students (O'Dea, 2012).

The review was conducted to identify gaps and provide recommendations for the assessment of an existing school-based nutrition program run by Foodbank Western Australia (WA) to optimise nutrition and health outcomes for participating children. In addition to being a part of Australia's largest food relief organisation, Foodbank WA also runs a *School Breakfast Program* (SBP), which exists in nearly 500 schools in WA. The SBP provides schools with a range of fresh and non-perishable products that are provided free of charge to give all students equal opportunity to receive a wholesome, nutritious breakfast on a regular basis (Foodbank WA, 2021). Schools registered with the SBP have access to *Food Sensations for Schools* (FSS), a fun and hands-on nutrition education program, with the aim of improving knowledge, attitudes, and skills to encourage healthy eating and cooking in school-based children. Briefly, the structure of the FSS program includes the provision of educational videos to the school prior to the education session, on knife safety and an introduction to the *Australian Guide to Healthy Eating* (AGTHE) (National Health and Medical Research Council, 2013), an education session covering the AGTHE,

an interactive nutrition activity, and a hands-on cooking and tasting session. Evaluations conducted on Foodbank WA's FSS program in recent years highlighted that the sessions resulted in improved knowledge and skills related to dietary guidelines, food selection, food preparation, and safe food handling (Begley & Bird, 2020). While these evaluations provide useful insights into the program's effectiveness, establishing best practice standards would be beneficial to guide and improve the development and implementation of these programs, and others.

Methods

This scoping review aimed to assess the effectiveness of nutrition education programs within the school setting reported in the existing literature using the PRISMA framework for scoping reviews (PRISMA-ScR) outlined by Arksey and O'Malley (2005).

Data sources and strategy

The search strategy used to source appropriate articles from scholarly databases was as follows; (Nutrition OR Cooking) AND Education AND (School OR Child* OR Class*). Databases used to search for research articles were *Web of Science*, *Cumulative Index to Nursing and Allied Health Literature* (CINAHL), and *Education Resources Information Center* (ERIC). The search strategy format was adapted for each database suitably.

Inclusion and exclusion criteria

This review evaluated the efficacy of nutrition education programs targeted at school-aged children from Kindergarten (aged 4) to Year 12 (aged 18). Following iterative search trials, the specific parameters that were investigated included changes in nutrition-related knowledge and the frequency of healthy eating behaviours. The programs included were to be developed by nutrition professionals and were required to be delivered by health professionals or teachers. Nutrition education and cooking programs within school settings in any geographical location were eligible for inclusion. Programs were included if they sought to derive improvements in nutrition and cooking knowledge and behaviours, and culinary skills in the participants; therefore, all included programs had to include nutrition education and cooking components. Particularly, specific components that were implicated in a program's success were explored and deduced. Programs were only included if they were delivered during school hours, i.e., after-school programs were excluded. Articles were excluded if their programs also addressed topics other than nutrition, i.e., physical education or other health topics and non-nutrition related outcomes were evaluated. Research articles published from 2010 to end 2020 were sought. Articles were required to be peer reviewed, written in English and with a full text version available.

Data extraction

The abstracts of the found articles were reviewed using a data extraction spreadsheet to record author, year of publication, sample size, outcomes, themes, limitations, additional

notes and suitability against the relevant selection criteria. The relevant articles were then reviewed thoroughly in their full text version by one reviewer to further evaluate their suitability and determine their inclusion in the review. A second reviewer then reviewed all of the full text articles to ensure reliability of data extraction and confirm inclusion in the review.

The final articles were mapped against the HPSF for each domain: education, environment, and partnerships (Figure 1). The mapping against the HPSF model involved identifying whether the programs evaluated in each article implemented strategies or elements that identified with those outlined in the HPSF's domains. The mapping data was used to extract the main themes that emerged from the articles, to provide a succinct depiction of what approaches and strategies were utilised to enhance the success of a school-based nutrition education and cooking program.

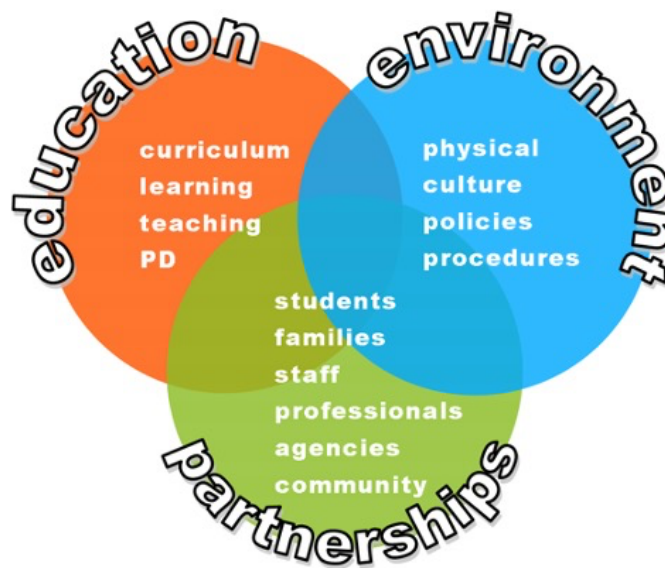


Figure 1: The interrelating domains of the *Health Promoting Schools Framework* (HPSF) and the elements within each domain that contribute to promoting a whole-school environment (Department of Health, 2023)

Findings

The initial search retrieved 549 articles of which six articles met the inclusion and exclusion criteria following the removal of duplicates and review as detailed in the methods (Figure 2).

The six articles selected for the scoping review were published between 2012 and 2016. A summary of each of the respective programs is shown in Table 1.

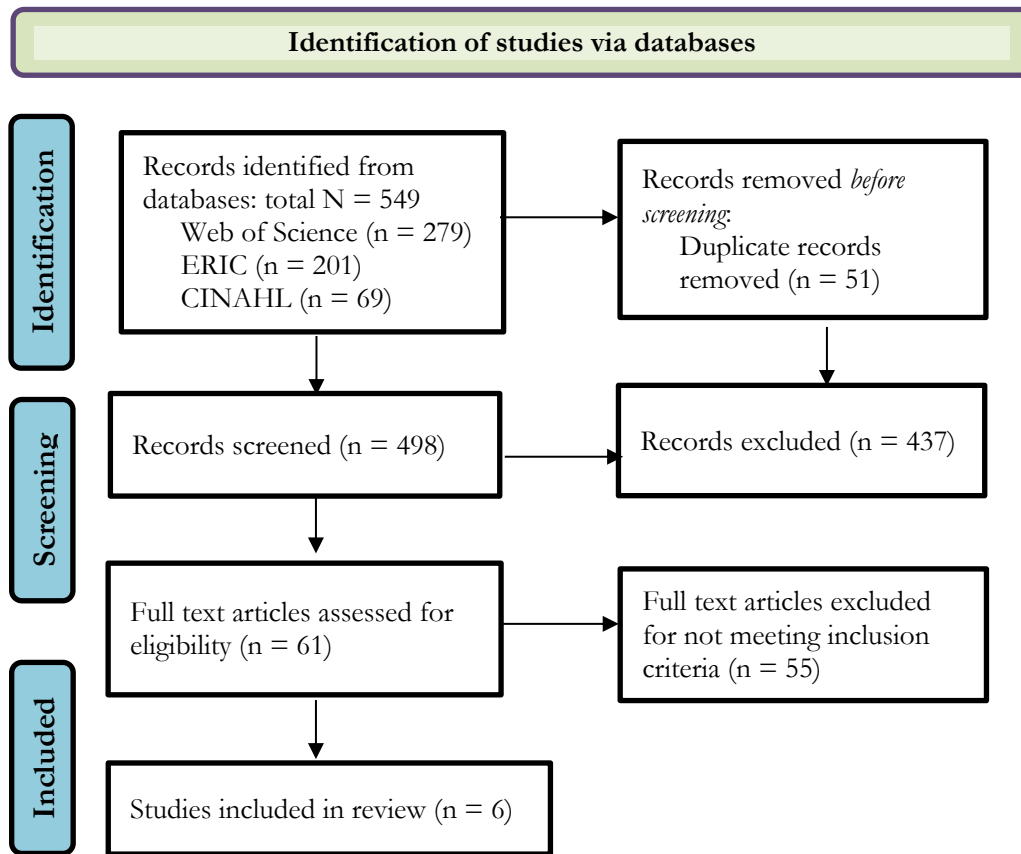


Figure 2: PRISMA 2009 flow diagram (Page et al., 2021)

Table 1: Program descriptions

Article	Program evaluated	Location	Theory utilised	Program outline	Time
Carraway-Stage et al. (2015).	Food, Math, and Science Teaching Enhancement Resource (Food-MASTER) Intermediate (FMI) curriculum	USA	Constructivist learning theory	Incorporates nutrition and cooking education via Math and Science subjects.	10 chapters, 24 x 45-minute classes over the year
Cunningham-Sabo and Lohse (2014)	Cooking with Kids-cooking and tasting (CWK-CT)	USA	-	Variations of the program with some only conducting tastings and no cooking involved.	16 hours over the school year, 5 x 1 hr sessions and 5 x 2 hr session

Article	Program evaluated	Location	Theory utilised	Program outline	Time
Gibbs et al. (2013)	Stephanie Alexander Kitchen Garden Program	Australia	Social-ecological theoretical model and principles of effective health promotion	Nutrition, cooking and gardening practical education	Over school year 135 min/week = 45 min/ wk in garden class with a garden specialist and 90 min/wk in kitchen with a cooking specialist
Jones et al. (2012)	Food for Life Partnership	UK	-	Nutrition education, cooking and gardening activities	Over a school year
Mittmann et al. (2016)	5-a-day for Kids Program	Germany	Did not specify	Theory, visiting a supermarket and hands-on cooking	One day (135 min) intervention. Incorporating three x 45-min sessions
Ruge et al. (2016)	LOMA	Denmark	HPSF and the Investigation, Vision, Action and Change (IVACE) approach	Nutrition, cooking and gardening practical education.	Over a school year

The emerging themes from the six programs are shown in Table 2, alongside the FSS program. The FSS program has not been used in this scoping review but is used as a comparison against the research's emerging program themes to clearly identify FSS program gaps.

Table 2: Emerging program themes from the final approved articles and the Food Sensations for Schools (FSS) program strategies

Themes	FMI	CWK-CT	SAKGP	FfLP	5-a-day	LOMA	FSS
Program integrated other school subjects (maths, science, English)		X		X		X	X
Prog. embedded into existing subjects/ periods (e.g. sci., maths, health educ.)	X		X				
Encourages peer role modelling	X	X	X	X	X	X	X
Whole-school approach	X	X	X	X		X	
Once-off session					X		X
Duration of program (>2 months)	X	X	X	X		X	
School garden implementation and educ.			X	X		X	
Excursions/incursions		X		X	X	X	X
Guest educators		X		X	X	X	X
Eating together	X	X	X	X	X	X	X
Educ. resources/packs for teachers	X	X	X	X	X	X	X
Provided teachers with professional dev.			X	X		X	X

Key	FMI	FoodMASTER Intermediate curriculum. Carraway-Stage et al. (2015)
	CWK-CT	Cooking with Kids-cooking and tasting. Cunningham-Sabo et al. (2014)
	SAKGP	Stephanie Alexander Kitchen Garden Program. Gibbs et al. (2013)
	FfLP	Food for Life Partnership. Jones et al. (2012)
	5-a-day	5-a-day for kids. Mittman et al. (2016)
	LOMA	LOMA-Local Food. Ruge et al. (2016)
	FSS	Foodbank WA's Food Sensations for Schools

Thematic mapping against the HPSF domains

Table 3 highlights the emerging themes mapped against the HPSF education, environment, and partnerships domains. Some articles did not specify what strategies were used during the implementation of the program; therefore, further details were sought directly via the program websites (Carraway-Stage et al., 2015; Gibbs et al., 2013; Jones et al., 2012; Ruge et al., 2016).

Table 3: Thematic analysis of nutrition education and cooking programs against the Health Promoting Schools Framework (Department of Health, 2023)

HPSF domain	FMI	CWK-CT	SAKGP	FfLP	5-a-day	LOMA	FSS
Education							
Program was embedded into the normal school curriculum	X		X				
Program integrated other subjects built into the program		X		X		X	X
Program was stand-alone from other school subjects					X		
Hands on activities (cooking, experiments)	X	X	X	X	X	X	X
Gardening			X	X		X	
Excursions (Farm visits, markets)				X	X	X	
Environment / Ethos							
Teachers provided with resources	X	X	X	X	X	X	X
Action groups/ committees inc. staff, students, parents and community				X		X	
Professional development of staff				X		X	
Whole-school approach including students, staff, parents		X	X	X		X	
School fairs or functions				X			X
Students involved with cooking and sharing of meal with other students and teachers outside of their class		X	X	X	X	X	
Encouragement of peer education	X	X			X	X	X
Provision of produce to school for cooking and/or canteen	X	X	X	X	X	X	X
Supportive of diverse cultural backgrounds		X	X			X	X

HPSF domain	FMI	CWK-CT	SAKGP	FfLP	5-a-day	LOMA	FSS
Partnerships / Community							
Encouraged schools to seek outside assistance from community and/or grants for resources	X		X				
Encouraged community/parental involvement i.e., newsletters, seeking volunteers during in-school activities, committees		X	X	X		X	
Encouraged parental in-home involvement worksheets, activities, recipes	X	X	X	X	X		X
Provided information to continue community/school/ parental engagement		X	X	X			X
Building relationships with farmers/fresh procurement businesses/farmers knowledge				X		X	
<i>Key</i>	FMI	FoodMASTER Intermediate curriculum. Carraway-Stage et al. (2015)					
	CWK-CT	Cooking with Kids-cooking and tasting. Cunningham-Sabo et al. (2014)					
	SAKGP	Stephanie Alexander Kitchen Garden Program. Gibbs et al. (2013)					
	FfLP	Food for Life Partnership. Jones et al. (2012)					
	5-a-day	5-a-day for kids. Mittman et al. (2016)					
	LOMA	LOMA-Local Food. Ruge et al. (2016)					
	FSS	Foodbank WA's Food Sensations for Schools					

Education domain

Carraway-Stage et al. (2015) and Gibbs et al. (2013) both outlined programs embedded into the normal school curriculum. Three programs cross-integrated with other school subjects (Cunningham-Sabo & Lohse, 2014; Jones et al., 2012; Ruge et al., 2016) and one program was a stand-alone program that did not integrate with the school curriculum (Mittmann et al., 2016). School curriculum subjects incorporated into their program included science, mathematics and English. All six programs used hands-on activities such as cooking or experiments, and half of the programs incorporated gardening into their programs and included excursions to farms or markets.

Environment domain

The most predominant theme extracted from the environment domain was that teachers or schools were provided with resources to assist the program. In addition to educational resources, all programs provided the schools with produce and/or cooking facilities/equipment to cook to assist the teachers. Five of the six programs adopted a whole-school approach and encouraged students and teachers to eat together, with half encouraging the cooking of culturally diverse food. Other themes included incorporating school leadership, staff development, food services, and school functions or fairs that encouraged student, family, and the broader community involvement in the promotion of healthy eating.

Partnership domain

Mapping against the HPSF partnerships/community domain, identified that all programs highlighted the need for community and parental engagement, which was encouraged, usually via school newsletters. Two programs promoted committees or groups that invited a whole community approach and encouraged the application of grants to purchase supportive resources. Locally sourced produce was also noted with farmers visiting schools or schools attending farms.

Discussion

The aim of this scoping review was to assess the effectiveness of nutrition education programs with a cooking component, conducted within the school setting. The WHO HPSF was overlaid on those programs meeting the inclusion criteria in order to identify program gaps in relation to the framework. Although at least one component of the three HPSF domains were observed across all six programs, no program included all components from all three domains.

Cross-integration of various school subjects into a program was a common theme identified. This emerging theme aligns with current research suggesting that an integrated cross-curricular approach has the greatest effect on improving dietary intakes, food and nutrition knowledge, and behaviours in school aged children (Love et al., 2020). In addition, it has been noted that this approach is more successful and well received by education professionals for the benefits it provides teachers and their overarching teaching goals (Carraway-Stage et al., 2015; Langford et al., 2015a; Ronto et al., 2017). The literature also stated that cross-curricular integration of food and nutrition education into other school subjects is encouraged for its ability to address time constraints during school (de Vlieger et al., 2020; Dudley et al., 2015). This integration of programs can enhance learning, through providing an increased relevancy to its application of learning in a real-life setting (Follong et al., 2020; Love et al., 2020).

Both nutrition educators and teachers must develop creative ways to manage different learning styles, as a single teaching style is not suitable for all children to learn and retain information (Broström et al., 2015; Carraway-Stage et al., 2016). Research has proven the incorporation of all five senses; taste, touch, smell, and sound, to be beneficial for education and information retention (Diker et al., 2011; Reverdy et al., 2008; Winter et al., 2012). This supports one of the identified themes of this review, with half of the programs incorporating school gardens or community gardens, alongside nutrition education and cooking activities (Gibbs et al., 2013; Jones et al., 2012; Ruge et al., 2016). In addition to school gardens, half of the intervention strategies included excursions to farms or markets or had these incursions at school (Jones et al., 2012; Mittmann et al., 2016; Ruge et al., 2016). Developing varied ways to educate children is congruent to the HPSF which underpins the reciprocal relationship between health and education (Langford et al., 2015b).

Studies have found that early nutrition intervention relating to the adoption of healthier eating behaviours in school-aged children may have significant lasting effects into adulthood and thus reduce chronic disease (Feldens et al., 2010; Langford et al., 2015b; Mikkila et al., 2004). Currently, Australian schools teach their students food and nutrition education within the Health and Physical Education (HPE) curriculum from pre-primary onwards (School Curriculum and Standards Authority, 2017b). Students' foundational cooking skills and exposure to cooking in a kitchen setting traditionally begins in Year 7 within the design and technologies curriculum, often referred to as Home Economics (School Curriculum and Standards Authority, 2017a). The Australian curriculum places importance on providing opportunities to students to learn about where food comes from, how it is produced, why they choose it, the benefits of healthy eating, what food is nutritious and how it can be prepared (ACARA, 2012).

Often, schools place higher value on academic achievement rather than health and nutrition education (Langford et al., 2015a; Langford et al., 2015b; Ronto et al., 2016). Although the school curriculum provides overarching goals, there is no standardised approach to teaching food and nutrition education (de Vlieger et al., 2020; Ronto et al., 2016). Teachers must follow broad goals when teaching food and nutrition-related information and the onus to locate resources and activities often falls solely on them (Love et al., 2020). For an intervention to be effective, it is necessary for educators to be well-trained and motivated (Kupolati et al., 2014). Several programs have identified this and offered teachers further professional development within their program's strategies (Beccarelli et al., 2017; Burgermaster et al., 2017; Stiefel et al., 2017). Carraway-Stage and colleagues (Carraway-Stage et al., 2016) noted the difference between students' food and nutrition education when compared with teachers' level of self-efficacy. It was found that teachers who displayed higher levels of food and nutrition knowledge spent more time delivering food and nutrition education with increased confidence compared with teachers who had low self-efficacy. However, providing teachers with professional development may exacerbate pressures already placed on teachers.

Partnership between teachers and nutrition educators was identified by four out of the six programs where both teachers and nutrition educators shared the role of the program delivery (Cunningham-Sabo & Lohse, 2014; Jones et al., 2012; Mittmann et al., 2016; Ruge et al., 2016). The remaining two programs provided teachers with education materials to deliver the intervention program themselves (Carraway-Stage et al., 2015; Gibbs et al., 2013). Research suggests providing standardised, scaffolded learning materials/activities in schools, delivered by both nutrition educators and teachers, may provide a harmonious environment for sustainable nutrition programs (Bodkin & Hakimi, 2020; Carraway-Stage et al., 2015). Collaboration between teachers and nutrition educators has proven to be beneficial for both nutrition educators and time poor teachers (Wheeler et al., 2018). Often nutrition educators are limited by their capacity to deliver to multiple schools, therefore working together to share the program delivery may prove to be a more sustainable arrangement for programs that have a longer implementation time. Time poor teachers may benefit by sharing the burden of delivering content to their students, with the collaborative approach increasing program fidelity with limited resources (Johnson et al., 2019; Wheeler et al., 2018).

Longer duration of a program was another theme that emerged from the scoping review, in all but one of the programs. The program that was an anomaly was delivered as an intensive one day intervention, broken into three sections; classroom-based education, excursion to a local supermarket, followed by food preparation and tasting (Mittmann et al., 2016). However, there were no significant findings observed at one, or three months post-program delivery. The remaining five programs were generally conducted once per week, over a school year (Carraway-Stage et al., 2015; Cunningham-Sabo & Lohse, 2014; Gibbs et al., 2013; Jones et al., 2012; Ruge et al., 2016). Research has indicated that approximately 10-15 hours of nutrition education is required to show improvement in students' nutrition knowledge, whereas it is estimated that 50 hours is necessary for health behaviour change to occur (Carraway-Stage et al., 2015; Gibbs et al., 2013). This review supports the notion, that longer intervention exposure increases healthy eating behaviors (Gibbs et al., 2013). Information about the duration of the interventions is outlined in Table 1.

Schools' supportive environments in promoting students' health and encouraging healthy behaviors was recognised across all the programs through various classroom activities and whole of school strategies. The combination of eating together, and peer and teacher role-modelling promotes healthy behaviours, further giving weight to the importance of a supportive school environment in successful programs, as highlighted in the HPSF (Carraway-Stage et al., 2015; Cunningham-Sabo & Lohse, 2014; Gibbs et al., 2013; Jones, 2019; Mittmann et al., 2016; Ruge et al., 2016).

Studies have identified a contrast in students' responses and behaviours to nutrition and cooking programs based on their teacher's interaction and involvement during the session. Students were more enthusiastic and exhibited an increased willingness to participate when teachers showed interest and role-modelled through sharing meals with their students, versus teachers who were unsupportive or showed disinterest in the program (Bai et al., 2011; Burgermaster et al., 2017; Mittmann et al., 2016).

Other strategies within the environment domain explored by programs included the provision of equipment and produce, the creation of health and wellness committees, and altering what food was available at school canteens (Carraway-Stage et al., 2015; Cunningham-Sabo & Lohse, 2014; Gibbs et al., 2013; Jones et al., 2012; Mittmann et al., 2016; Ruge et al., 2016). Some schools provided a health promoting environment by holding health fairs at the school (Jones et al., 2012), which further strengthened school commitment to providing a health promoting school environment and boosted school morale. Adopting a whole-school approach was a prominent theme. A collaborative, whole-school approach has been shown to improve the success of interventions as well as provide the much-needed support to teachers (Bodkin & Hakimi, 2020; Langford et al., 2015a; Lee et al., 2020). Teachers have mentioned the importance of a whole-school approach to ensure consistency of messages taught in the classroom and experienced within the school environment, such as healthy canteen choices, and other health promoting policies (Love et al., 2020). Bringing individuals and the community together to support a common vision, may encourage capacity building for a sustainable healthy school environment and intervention program (Jones, 2019; Scherr et al., 2014).

As noted in Table 2, many programs encouraged partnerships and community interaction which assists with capacity building and elongating the sustainability of interventions. Many programs encouraged schools to ask the community, parents, and staff for assistance with school gardens and/or parental involvement via newsletters. The schools were also encouraged to apply for grants, seek donations from local businesses for equipment and materials and procurement of produce and/or guidance through experienced farmers (Carraway-Stage et al., 2015; Cunningham-Sabo & Lohse, 2014; Gibbs et al., 2013; Jones et al., 2012; Mittmann et al., 2016; Ruge et al., 2016). Having the broader community show support and collaborate with the school and students further reinforces and solidifies what is taught in the school curriculum, supports teachers, and increases the sustainability and longevity of the program and the school's health promoting environment (Bodkin & Hakimi, 2020; Love et al., 2020; Ruge et al., 2016; Wheeler et al., 2018).

Promoting a sustainable school-based nutrition education program

This scoping review has helped to establish a set of recommendations that should be encouraged when developing a school-based nutrition education and cooking program, to enhance its likelihood of success.

- It is recommended that a program should be conducted over multiple sessions, over an extended period of time, given that it was found that 10-15 hours of nutrition education is required to show improvement in students' nutrition knowledge and that 50 hours is necessary for health behaviour change (Carraway-Stage et al., 2015; Gibbs et al., 2013).
- The role modelling of teachers in demonstrating and supporting healthful behaviours is a simple yet powerful health promoting strategy. Enhancing teachers' own food and nutrition knowledge has also resulted in teachers spending more time delivering food and nutrition education to their students and received positive feedback from students (Carraway-Stage et al., 2016). Providing additional opportunities for improving teacher food and nutrition knowledge is warranted and for staff and schools to invest in professional development in this area.
- Providing standardised learning materials with scaffolded learning activities, delivered by both nutrition educators and teachers, may provide a harmonious environment for sustainable nutrition interventions (Bodkin & Hakimi, 2020; Carraway-Stage et al., 2015). Recognising the importance of co-facilitation support for teachers with qualified nutrition health professionals will build confidence and sustainability of school-based nutrition education programs.
- Delivering food and nutrition education as an integrated cross-curricular approach has the potential to have a substantial effect on improving dietary intakes, food and nutrition knowledge, and behaviours in school aged children (Love et al., 2020). Additionally, the incorporation of all five senses, taste, touch, smell and sound, has

been shown to be beneficial for education and information retention (Diker et al., 2011; Reverdy et al., 2008; Winter et al., 2012).

- While recognising the importance of a whole of school approach, looking more widely than the immediate school setting and bringing individuals and the community together to support a common vision, may encourage a sustainable healthy school environment and intervention program (Jones, 2019; Scherr et al., 2014).

Limitations

As with all scoping reviews, this work did not assess the quality of evidence presented in the included studies. While the FSS evaluations demonstrate real world program effectiveness to funders, essentially these remain absent from the peer review literature where the requirement for a comparator group is an unfeasible limitation but often a necessity for publication. Given the breadth of a scoping review which includes a range of study designs and methodologies, definitive conclusions cannot be made from this review alone. The search strategy was limited to the last decade and it is possible that relevant articles were missed; however most studies were published in the mid 2000s and the authors are confident to have captured the majority of articles on this topic. The databases were selected to capture published programs across the domains of education and nutrition science. Using *Google Scholar* in the search strategy may have permitted the inclusion of a broader range of findings including some from low income countries. The narrow search parameters meant the review focused on school nutrition education and cooking programs, and that the findings could not be applied to a broader range of school based programs, by their topic or age group. Further research could focus on programs that address broader health education topics and age groups.

Conclusions

Schools provide a prime and timely opportunity to promote health and instil healthy eating behaviours in children by creating a supportive environment to encourage behaviour change and develop lifelong skills that will be carried into adulthood. The findings of this scoping review suggest that the combination of nutrition education and hands-on activities such as cooking classes and growing produce in school gardens can induce positive behaviour changes in school-aged children. Programs that promote a supportive school environment, encourage broader community involvement and parental support have been shown to increase program effectiveness. Extended program duration and integration of cross curriculum subjects were other common themes found in this scoping review that can consolidate learning and skills and may enhance effectiveness and long-term success of nutrition education programs. These recommendations, along with increased collaboration between teachers and nutrition educators, reflect a health promotion approach with key elements of the HPSF, working synergistically at multiple levels.

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Human subjects approval statement

Preparation of this paper did not involve primary research or data collection involving human subjects, and therefore, no institutional review board examination or approval was required.

Conflict of interest disclosure statement

All authors have no conflicts of interest.

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