# A systems approach to improving healthy eating in early childhood

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## Thesis abstract

Optimising nutrition in the first 2000 days is crucial for establishing health eating habits and reducing the risk of poor health outcomes later in life. Despite public health efforts, children continue to fall short of meeting dietary guidelines. A systems-based approach is needed to address the complex network of determinants that influence the diets of young children. Creating healthy food systems, which encompasses immediate parental and household influences as well as the broader food environment, can support children to meet their nutritional needs. Centre-based childcare provides education and care to more than 60% of Australian children and up to two thirds of their daily intake of food and nutrients making it an important setting to shape children's diets. However, implementation challenges may inhibit the success of healthy eating interventions. The most effective ways to improve children's diets and nutrition in this setting remains unclear. The aim of this thesis was to identify key leverage points to intervene in the food system and inform recommendations for strengthening action in the early childhood education and care setting to improve children's diets.

Synthesising and mapping the existing evidence is essential for identifying research gaps and informing the development of system-based solutions. A scoping review was conducted to determine: (i) what determinants have been addressed by existing early childhood nutrition interventions (Chapter Two), and (ii) which determinants respond to intervention to improve dietary intake (Chapter Three). A total of 193 studies were included in the review. Findings highlighted the need for policy level action to enhance home food availability and accessibility, strengthen implementation in the early childhood education and care (ECEC) setting and regulate food marketing directed at children.

To inform policy solutions in the ECEC setting within a systems approach, it is necessary to understand the broader social, cultural, economic and environmental factors that influence the implementation of healthy eating policies and practices. Two qualitative studies were conducted to understand how these factors influence implementation from the perspectives of directors (Chapter Four) and educators and cooks (Chapter Five). Semi-structured interviews were conducted with twelve directors and ten educators and cooks from centre-based ECEC services. Findings highlighted

the need to strengthen systems-level action to support implementation and ensure success of healthy eating policies and practices. There remain opportunities to strengthen multisectoral partnerships to address fragmented systems of support, foster partnerships with parents and the community, improve access to professional development and industry networks for educators and cooks, and increase investment in the ECEC sector to address current staffing and funding challenges. Together, findings from this research informed recommendations for policy and practice as part of a systems approach to improve the diets of young children (Chapter Six).

## Statement of originality

This is to certify that to the best of my knowledge, the content of this thesis is my own work. This thesis has not been submitted for any degree or other purposes.

I certify that the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources have been acknowledged.

Jacqueline Chan

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# Authorship attribution statement

## Thesis journal publications

The following peer-reviewed publications arose directly from research conducted as part of the PhD candidature.

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JC, PP, DR and MAF were involved in the conceptualisation and design of the study. JC led the data collection and analysis. JC and PC screened articles and extracted data, with assistance from MAF to resolve uncertainties. JC drafted the manuscript, and all authors were involved in review and editing of the final manuscript.

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JC, PP, DR and MAF were involved in the conceptualisation and design of the study. JC led the data collection and analysis. JC and PC screened articles and extracted data, with assistance from MAF to resolve uncertainties. JC drafted the manuscript, and all authors were involved in review and editing of the final manuscript.

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JC, PP, DR and MAF were involved in the conceptualisation and design of the study. JC and AHP were involved in participant recruitment. JC led the data collection and analysis. MAF was the second data coder and reviewed a sub-set of the data. JC drafted the manuscript, and all authors were involved in review and editing of the final manuscript.

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As supervisor for the candidature upon which this thesis is based, I can confirm that the authorship attribution statements above are correct.

Margaret Allman-Farinelli

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## Conference presentations

The following oral and poster presentations arose directly from research conducted as part of the PhD candidature:

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## Additional peer-reviewed publications

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## Human research ethics approval

The qualitative studies with directors presented in **Chapter Four** and educators and cooks presented in **Chapter Five** were approved by the Sydney Local Health District Human Research Ethics Committee (HREC) – RPAH Zone, Protocol No X23-0379 & 2023/ETH02140.

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## Abbreviations

| | |
|---|---|
| **ACECQA** | Australian Children's Education and Care Quality Authority |
| **AUD** | Australian Dollar |
| **BMI** | Body Mass Index |
| **CACFP** | Child and Adult Care Food Program |
| **CENTRAL** | Cochrane Central Register of Controlled Trials |
| **CFIR** | Consolidated Framework for Implementation Research |
| **DONE** | Determinants of Nutrition and Eating |
| **ECEC** | Early Childhood Education and Care |
| **EDNP** | Energy-Dense Nutrient-Poor |
| **EYLF** | Early Years Learning Framework |
| **FV** | Fruit and Vegetables |
| **HIC** | High-income countries |
| **JBI** | Joanna Briggs Institute |
| **NCDs** | Non-communicable diseases |
| **NGO** | Non-government Organisation |
| **NSW** | New South Wales |
| **NQS** | National Quality Standards |
| **NQF** | National Quality Framework |
| **OPR** | Overall Priority of Research |
| **PRISMA** | Preferred Reporting Items for Systematic Reviews and Meta-Analysis |

| | |
|---|---|
| **RCT** | Randomised Controlled Trials |
| **REDCap** | Research Electronic Data Capture |
| **SEIFA** | Socio-Economic Indexes for Areas |
| **SRQR** | Standards for Reporting Qualitative Research |
| **SSB** | Sugar-sweetened beverage |
| **UK** | United Kingdom |
| **US or USA** | United States of America |
| **USD** | United States Dollar |
| **WIC** | Special Supplemental Nutrition Program for Women, Infants, and Children |
| **WHO** | World Health Organization |

# Chapter One: Introduction

## 1.1 Background

### *1.1.1 Sub-optimal diets and burden of disease*

Sub-optimal diet is a leading modifiable risk factor for the global burden of disease (1). In 2017, dietary risk factors were estimated to contribute to 11 million deaths and 255 million years of healthy life lost to premature mortality or disability (2). Dietary risk factors include high intake of sodium and low intake of wholegrains, fruits, nuts and seeds, and vegetables. Furthermore, excessive consumption of foods high in added sugar, saturated fat, sodium, and additives are associated with increased risk of non-communicable diseases including overweight and obesity, metabolic syndrome and depression (3). Adherence to healthy dietary patterns such as the Mediterranean diet, low-inflammatory diet and following Australian dietary guidelines is associated with reduced all-cause and cardiovascular risk (4).

Despite global efforts, sub-optimal diets remain a public health challenge. Estimates from the Australian Burden of Disease Study 2024 revealed that overweight and obesity has overtaken tobacco as the leading modifiable risk factor contributing to total disease burden in Australia, followed by dietary risks as the third leading risk factor (5). Dietary risk factors include diets low in legumes, wholegrains and high fibre cereals, and diets high in sodium and red meat. It was estimated that 8.3% of the total disease burden was attributable to overweight and obesity and a further 4.8% was attributable to dietary risks.

### *1.1.2 Importance of nutrition in early childhood development*

The first 2000 days of a child's life from conception to five years of age has been proposed as a critical window of opportunity for early intervention to achieve optimal health and wellbeing outcomes across the lifespan (6). The first 2000 days is a period of rapid physical, social, emotional, and cognitive development and plays a crucial role in shaping lifelong habits (7). During these early years, establishing optimal diet and nutrition is pivotal for ensuring children thrive and reach their

developmental potential (8). Ensuring optimal nutrition is necessary for musculoskeletal development, physical growth and can prevent stunting and infection during childhood (9-11). Additionally, there are benefits for cognitive, language, and motor development during infancy and preschool years and ensuring school readiness (12, 13). Diet quality is associated with improved health outcomes in children including improved IQ, reduced risk of metabolic syndrome, lower blood pressure and HbA1c levels, reduced risk of metabolic syndrome and an overall improvement in mental health-related quality of life (14). Research suggests that dietary patterns are established in early age and remain consistent into adulthood (15).

Sub-optimal diets in early childhood are associated with excessive weight gain and increased risk of overweight and obesity in childhood (16, 17). These risks extend beyond early childhood and track into adolescence and adulthood. The Developmental Origins of Health and Disease hypothesis proposes that early life exposures can have long term effects on later health outcomes (18). Nutritional exposures in early life can influence metabolic programming and cause epigenetic modifications due to the plasticity of cells and tissues during development (19). There is evidence to show that sub-optimal diets in early years can increase risk of non-communicable disease including obesity and cardiometabolic disease later in life (20-22).

### *1.1.3 Economic consequences*

The disease burden attributable to sub-optimal diets result in substantial economic costs to the healthcare system. According to the latest data on Australian health system spending, $1.8 billion of the estimated spending in 2018-19 was attributable to potentially avoidable disease due to dietary risk factors (23). When combined, all diet-related risk factors, including overweight and obesity, contributed to approximately $AUD 16.2 billion of spending (23). Globally, the annual cost to the healthcare system due to childhood obesity is predicted to be $13.62 billion and $49.02 billion (in 2022 US Dollars) in direct and indirect annual costs respectively by 2050 (24). In Australia, reducing the prevalence of childhood and adolescent overweight and obesity by 5% by 2030 is estimated to save $7.44 billion (in 2030 AUD), mostly through reductions in obesity-related healthcare costs

across the life course and premature mortality (25). Investment in early childhood nutrition interventions can reduce the economic burden of diet related non-communicable diseases (26).

### *1.1.4 Poor diet among preschool aged children*

Globally, children are not meeting dietary guidelines for fruit and vegetables and have poor dietary patterns high in energy-dense nutrient-poor (EDNP) foods and sugar-sweetened beverages (SSB) (27). In the United States, nearly one-half of children aged 1 to 5 years did not eat a daily vegetable and more than one-half drank SSB at least once daily (28). Furthermore, an analysis of the United States (US) National Health and Nutrition Examination Survey 2015-16 estimated that 40% of children aged 2 to 5 years have poor quality diets (29). Poor quality diet was defined as less than 40% adherence to the American Heart Association Continuous Diet Score 2020. Currently, Australian children are not meeting national dietary guidelines, putting them at risk of poor health outcomes. In 2022, only 20% of children aged 2 to 3 years and less than 2% of children aged 4-8 years were meeting recommendations for fruit and vegetables (30). Additionally, most children aged 2 to 3 years were not meeting the recommendations for other key food groups as recommended by the Australian Dietary Guidelines including meats and wholegrains, and exceeding recommendations for EDNP foods and SSB (31). As such, there is increasing urgency to support Australian children to achieve healthy diets and healthy growth and development outcomes.

### *1.1.5 Determinants of children's diets*

Children's diets are complex, influenced by many interacting factors that make it challenging to attain healthy diets during early childhood (32). At the individual level, children's diets can be associated with demographic characteristics such as sex, ethnicity, and body mass index (BMI). For example, in preschool aged children being underweight is associated with lower diet diversity and having a higher BMI is associated with greater consumption of energy (33). Children's diets can be shaped by individual biological characteristics such as predisposition to tasting bitter compounds, and non-food related psychological characteristics, such as emotional self-regulation (33). These factors are associated with the development of food neophobia, characterised by the reluctance to eat unfamiliar

foods, which peaks between 2 and 6 years of age (34). During early years, parents and caregivers are considered 'gatekeepers' of children's diets and nutrition. Children are dependent on parents and caregivers for food preparation and children's behaviours are influenced by parental feeding practices such as role modelling of eating behaviours and encouragement to eat (35). Additionally, children and parents interact with their physical, economic, political and sociocultural environments which play a crucial role in shaping children's diets (36). The food supply chain involves activities related to the production, storage, distribution, processing and packaging of food (37). Food environments provide an interface where children and families interact with the food supply chain. For instance, supermarkets, early childhood education and care, and the home settings which children and parents interact with to procure, prepare, and consume foods (37). To add further complexity, the increasing use of digital technologies and social media has given rise to the digital food retail environment such as online food delivery platforms, which provide a new context for marketing and purchasing food for consumption (38).

### *1.1.6 The current food system*

The food system describes the interactions and feedback loops between the food supply, food environments, and behaviours of children and families (37). The 2017 *Nutrition and food systems* report by the High Level Panel of Experts on Food Security and Nutrition describe three types of food systems: traditional, mixed and modern food systems (36). The modern food systems closely reflect the current food systems in high-income countries similar to Australia, where there is an abundance of highly-processed food which promotes excessive energy intake (36). It has been proposed that changing dietary patterns and the high prevalence of overweight, obesity and chronic disease have largely been driven by the transformation of the modern food system (39). Food production and processing has been industrialised allowing for the expansion of types and quantities of ultra-processed foods high in sweeteners, fats, sodium and additives (40). Furthermore, technology and globalisation of food distribution has led to changes in the food landscape and increased accessibility and affordability of ultra-processed foods (40). In addition to accessibility and availability of unhealthy foods and drinks, food marketing in and around children's food environments may confuse

parents and make children vulnerable and susceptible to poor dietary outcomes (32). Public health policies play an important role in driving and re-orienting the food system to ensure safe and sustainable health outcomes for children (41).

### 1.2 Public health response

Food systems can support the delivery of healthy, affordable and sustainable diets and play a critical role in shaping children's health and nutrition outcomes (36, 37). There has been increasing attention to transform the current food system to address the disease burden related to sub-optimal diets and achieve the global nutrition targets as set by the United Nations as part of the Sustainable Development Goals. Goal 2 outlines targets to work towards achieving zero hunger, food security, and improving nutrition and sustainable agriculture by 2030 (42). This includes targets to stop the increase of childhood overweight by 2025, with aims to reduce childhood overweight to less than 3% by 2030 (42).

Early childhood has been recognised as an international priority for ensuring optimal diets and nutrition and disease prevention. Following the publication of *The Lancet's Child Development in Developing Countries* series in 2007 and 2011, there has been a substantial increase in the number of publications related to early childhood development (43). These studies showed children exposed to adverse conditions were associated with poorer social and health outcomes (44). Investments in children's health, nutrition, education, and development are crucial to ensure children reach their developmental potential and compound lifelong benefits that last into the next generation (45). In 2017, a new Lancet series, Advancing Early Childhood Development Series: from Science to Scale was published to synthesise the evidence for interventions and recommend strategies to improve child development outcomes (44). Evidence from both low- and middle-income and high-income countries shows that early childhood development programs face persistent challenges, including inadequate and uncertain funding, inefficient resource allocation across sectors, insufficient levels of trained staff and poor monitoring and evaluation (46). As such, program quality and their impact on child

development outcomes remain inconsistent across implementation contexts. Similarly, interventions to improve diet and nutrition in early childhood have been well-explored, but what works to successfully implement and sustain these interventions in real-world settings remains unclear (47-49). Programs and services to support early childhood development remain fragmented and mechanisms to successfully implement multi-sectoral policies remain uncertain (50).

### *1.2.1 A systems-based approach*

Interventions, usually developed in ideal research conditions, may not produce the intended outcomes in real-world implementation due to the interactions of actors across the food system that attenuate impact of the intervention (51). Whole-of-systems or systems-based approaches aim to understand how determinants interact in economic, social, physical and political environments within complex systems and can help us to understand and address complex public health challenges (52). A systems-based approach recognises and takes into consideration all determinants influencing children's diets and nutrition within the food system and allows researchers to identify cross-sector solutions to address complex challenges from multiple angles (51). A number of system-based approaches have been used in development of public health policies. These include research with a systems lens, concept mapping, system dynamics modelling, agent-based modelling and causal loop diagrams (51). For example, community-based participatory system dynamics modelling has been used to develop, implement, and evaluate a whole of community childhood obesity prevention intervention in Victoria Australia (53). This approach has demonstrated success in engaging the community and catalysing community-led actions.

### *1.2.2 Transforming the food system for children*

A system-based approach is necessary for transforming the food system to better support young children, given the complex and interrelated factors that influence their diets. Addressing these challenges requires all sectors including government departments and nongovernmental actors to work together (51). It involves a combination of cohesive upstream policy action that targets broader social, cultural, economic, and environmental factors, as well as downstream approaches that focus on

the individual such as provision of education and information. Transforming the food system can deliver multiple benefits across sectors, not only improving dietary intake and health outcomes, but also support environmental sustainability such as reducing food waste (54). For example, school meal programs and food marketing restrictions can promote the consumption of healthy, local foods and reduce reliance on EDNP packaged foods.

### *1.2.3 Public health policies in Australia*

System-based approaches targeting early childhood strategically align with Australian public health policy. In response to the chronic disease burden in Australia, the federal government released the *National Preventive Health Strategy 2021-2030*, a ten-year strategy which aims to improve the health and wellbeing of Australians through a systems-based approach to early intervention (55). The strategy emphasises the necessity to address the wider determinants of health and reduce health inequities and recognises early childhood nutrition as an important strategy to ensure all Australian children have the best start to life. Additionally, the *National Obesity Strategy 2022-2032* acknowledges the need for a healthy and equitable food system to prevent, reduce and treat overweight and obesity in Australia (56).

## 1.3 The early childhood education and care sector

The Early Childhood Education and Care (ECEC) sector provides a critical starting point for early intervention given its role in children's development and wellbeing (57). The United Nations Sustainable Development Goals calls for all children to have access to quality early childhood education and care under Target 4.2 (58). High-quality ECEC provides a foundation for children's language, cognitive, social and emotional skills as well as fostering long-term impacts on educational attainment and wellbeing later in life (59-61). This is well recognised, and many countries have implemented policies to increase enrolment in ECEC. Since 2008, enrolment of Australian children in ECEC has improved following policy reforms to increase access to preschool by providing all children with access to 15 hours per week for 40 weeks under the Universal Access National

Partnership 2008 – 2021 (62). From 2022, a further $2 billion AUD was invested to renew the Preschool Reform Agreement 2022 – 2025 (63). As a result over 90% of children attend ECEC in the year before entering primary school (62). Furthermore in New South Wales (NSW), the state government has made a commitment to build 100 new public preschools by 2027 (64).

The structure of ECEC systems varies across different countries which influences the implementation of social and family policies. In Australia, there are two types of ECEC services available to children and parents which include centre-based ECEC and home based family childcare (65). Centre-based ECEC for children includes kindergarten, preschool, or long-day care. In Australia, ECEC services are delivered through a mixed market of private, government and community-based providers, with the majority being for-profit services offered by private providers (66). Long day care services provide childcare to children aged six weeks to five years and may also provide preschool programs, also referred to as kindergarten in some states, aimed at children from the age of three. Preschool or kindergarten programs can also be provided by preschools operated by government and non-government organisations such as catholic schools. Financial support is provided by the Australian Government to help families with the cost of childcare through the Child Care Subsidy (66).

ECEC provides care to many children and families. On average, ECEC services in Organisation for Economic Co-operation and Development member countries provide care for 84% of children aged 3 to 5 years (65). In Australia, 50% children aged 0 to 5 years attended centre-based ECEC services and spend on average 27 hours per week in care (67, 68). Children aged 2-3 years are the most likely to attend formal care which includes long day care, before and/or after school care, family day care and occasional care. In 2017, 38% of children aged 2-3 years attending formal care, compared to 16% of children aged under 2 years, and 24% children aged 4-5 years (69). However, this excludes data on children attending preschool which is collected separately. In 2017, nearly 90% of eligible children were enrolled in a preschool program, with more children enrolled through a long day care service than preschool (70). Overall, the available data indicates that a substantial proportion of children aged 2–5 years attend formal childcare.

ECEC services can provide 50% to 67% of their daily recommended intake of food and nutrients making this setting a valuable intervention target for the promotion of healthy eating (71-73). Long day care services are open for at least eight hours per day and must provide one main-meal (lunch) and two mid-meals (morning and afternoon tea) to meet at least 50% of children's recommended daily intake (74). The type of food provision in long day care services varies from food being prepared and cooked on site by a cook or chef, provided by third party caterers or by parents (lunchbox services). Evidence from Queensland indicates that 71% of ECEC services provide meals, with services from rural and remote communities less likely to provide meals (75). However, there is a lack of data on the proportion of services using each method across the Australian ECEC setting (76). Outside of the home environment, ECEC services, particularly long day care services are an influential setting where children are exposed to food and nutrition. When services provide meals, they can directly support optimal nutrition during a period of rapid growth and learning, reduce disparities for children experiencing food insecurity, and ensure consistent exposure to healthy foods (75). Given the important role of ECEC services in supporting children's growth and development through food and nutrition and the continued commitment from Australian governments to increase access to ECEC, greater support is needed to ensure services provide high quality meals and foster healthy food environments for children.

### *1.3.1 The Australian policy context*

In Australia, all registered ECEC services are required to comply with the *National Quality Framework* (NQF). Implementation of the NQF is supported by a national regulatory body, the Australian Children's Education and Care Quality Authority (ACECQA). The NQF includes National Law and Regulations, the *National Quality Standards* (NQS) which set quality benchmarks for the ECEC sector, and approved national learning frameworks including the *Belonging, Being and Becoming: The Early Years Learning Framework for Australia (EYLF) 2022* for children 0 to 5 years. The EYLF sets out five key learning outcomes focused on identity, connection, wellbeing, learning, and communication that assists educators in implementing educational programs and practices in ECEC. Within the EYLF, nutrition is embedded within *Learning Outcome 3: Children have a strong*

*sense of wellbeing*, which outlines guidance for educators to "engage children in experiences, conversations and routines that promote healthy lifestyles and good nutrition" (77). Services are assessed and rated by regulatory authorities at the state level, usually government education departments, against seven quality areas outlined by the NQS (78).

The NQF references healthy eating through NQS Standard 2.1 which states "Healthy eating and physical activity are promoted and appropriate for each child" (79). However, support and guidance to operationalise the standards for health eating is limited. At the national level, *Get Up & Grow* resources provide guidance for healthy eating and physical activity best practice, but have not been updated since 2013 (80). Varying levels of support are also provided by state health departments to meet healthy eating guidelines (81). Currently only NSW (Munch & Move), Victoria (Healthy Eating Advisory Service) and Tasmania (Move Well Eat Well) are funded to deliver support services (82). For example, in NSW the *Caring for Children* framework was developed to provide best practice guidelines on food, nutrition and learning experiences for the ECEC setting (74). Additionally, local health services across NSW deliver the *Munch & Move* program to support implementation of healthy eating and physical activity in ECECs through provision of training, resources, and support visits (83). In Western Australia and South Australia, the *Start Right Eat Right* program was a nutrition award scheme which incentivised ECEC service to update their policies and menus but has since been discontinued (84). As such, there have been calls for access to funded state-wide nutrition support across all states and territories in Australia (84). National alignment of food provision guidelines is recommended to enable the provision of support and resources across Australia (81). Furthermore, updated national support tools and resources that are relevant to the current experiences and priority areas such as food safety and allergy management are needed (85).

In NSW, the *Caring for Children* framework focuses on two distinct age groups, recognising the different developmental stages and nutrient needs of infants and toddlers (birth to 24 months) compared with children aged 2 to 5 years old (74). The recommendations for the birth to 24 months age group is based on the *Infant Feeding Guidelines* (2012) and emphasise breastfeeding, preparing infant formula, introduction of solid foods and choking prevention. The recommendations for children

aged 2-5 years translates guidelines from the *Australian Dietary Guidelines* (2013) and specify minimum daily serves from the five food groups to ensure that children in care for eight hours or more receive at least 50% of their Recommended Dietary Intakes for all nutrients.

### *1.3.2 Healthy eating practices in ECEC*

ECEC services can promote healthy eating by providing opportunities to build children's knowledge and skills, creating supportive environments, engaging with families and local communities, and ensuring food provided is safe and culturally appropriate (86). For example, services can foster children's nutrition knowledge by providing opportunities for nutrition education and training for staff and healthy eating learning experiences for children. ECEC services can create supportive environments by implementing comprehensive centre nutrition policies, promoting staff role modelling of healthy eating behaviours, providing healthy food and beverages, and ensuring adequate space for staff and children to prepare and consume food. Additionally, ECEC services can engage parents and caregivers in menu planning, policy, and program decisions to strengthen family and community partnerships and ensure food provided is culturally appropriate.

A systematic review of healthy eating policies and guidelines in high-income countries found that guidelines frequently addressed the physical and sociocultural environment, but further consideration of policy and economic environments were needed (87). Research suggests that while many Australian ECEC services have centre-based nutrition policies in place, the language used often lacks clarity and the content included is not sufficiently comprehensive (88). In Australia, cross-sectional studies assessing the implementation of healthy eating practices in ECEC services have found that practices related to encouraging consumption of age-appropriate beverages and nutrition education and training for educators have the lowest prevalence of implementation (89, 90). Furthermore, ECEC services may not be meeting nutrition guidelines which recommend that at least 50% of the Australian Dietary Guidelines standard serves across the five food groups including fruits, vegetables, meat, dairy, and grains, should be provided to children while in care. In NSW, an analysis of 46 menus found that none of the services met recommendations for all five food groups (91). Similarly, an analysis of meals provided from eight centres in Western Australia, found that no services were

meeting recommendations for all five food groups (92). Additionally, research suggests that EDNP foods high in added sugar, saturated fat, sodium were regularly provided in Australian ECEC services (93).

### *1.3.3 Healthy eating interventions in the ECEC setting*

There is abundant evidence exploring the effectiveness of nutrition interventions to improve the diets of children in the ECEC setting. Multicomponent interventions combining nutrition and physical activity have been shown to be effective at making small reductions in zBMI and BMI scores in children aged 0 to 5 years (94). However, when examined by settings, interventions were effective in the home and community settings, but no effect was seen in the ECEC setting (94). In an umbrella review of healthy eating interventions in the ECEC setting, it was found that interventions were more likely to have success in improving children's diets and food choice if they were multi-component, addressing both physical activity and diet, individual and environmental-level determinants, and actively engaging parents (95). However, implementation success was not replicated without support from researchers or external experts (95). A Cochrane systematic review of healthy eating interventions delivered in the ECEC setting found that interventions led to small improvements in children's diet quality and fruit intake, however, found little to no effect on vegetable, EDNP food and SSB intake (48). In a systematic review of the effectiveness of strategies aimed at improving policy, practice and program implementation in childcare services, it was found that while strategies can improve implementation, the interventions had little or no difference on children's diets (96). These findings suggest that, although the benefits of improving children's diets are well established and diets within ECEC settings are suboptimal, existing interventions have demonstrated limited effectiveness. This highlights a gap in our understanding of how to translate interventions to achieve sustained implementation of healthy eating policies and practices in real-world ECEC settings.

## 1.4 Implementation challenges and contextual factors

Implementation challenges in health often arise as a result of contextual factors that may not have been considered in intervention design and planning (97). "Context" describes the characteristics and

circumstances surrounding implementation and can influence the effectiveness and reach of complex interventions (98). It describes the "often bumpy interface between what can be achieved in theory and what happens in practice" (97). A greater understanding of the contextual challenges in the real world can improve uptake of evidence-based interventions and translation of intended dietary outcomes in the ECEC setting. It has been proposed that identification of contextual barriers and facilitators of complex, real world implementation settings is an important step to allow for early planning to identify strategies for successful translation and sustained practice in the local context (99). Moreover, there are differences in provision of healthy eating support within Australia. As such, healthy eating policies and practices must take these complexities into consideration to realise their potential and ensure success of implementation. Integration of a systems-based approach and implementation research can have synergistic effects and strengthen sustained systems-level change (100).

### 1.5 Thesis aims

The objective of this research is to understand how we can use a systems approach to improve the implementation of evidence-based nutrition interventions and inform the development of recommendations for policy and practice in the ECEC setting. Within the ECEC setting, long day care services that provide meals to children offer a significant opportunity for public health nutrition interventions as they implement standardised menus and are responsive to policy and practice guidelines. The research in this thesis will focus on children aged 2 to 5 years as the key age group utilising long day care. Given that children under the age of two years have different dietary requirements for development, focusing on children aged 2-5 years can generate evidence to inform policy and practice tailored to their needs and better align with existing *Caring for Children* guidelines. The specific aims of this research are:

1) To map early childhood nutrition interventions and quantify food system determinants most frequently addressed and those overlooked

2) To synthesise evidence on the impact of early childhood nutrition interventions on children's diets and identify food system determinants for strengthening action
3) To explore contextual factors influencing Australian ECEC directors' decisions to implement healthy eating policies and practices in the ECEC setting
4) To explore contextual factors influencing the implementation of healthy eating policies and practices from the perspectives of Australian early childhood educators and cooks
5) To integrate the evidence from Aims One to Four and make recommendations for strengthening action to improve the diets of children aged 2 to 5 years in ECEC.

## 1.6 Thesis outline

This section provides an overview of the chapters in this thesis (Figure 1.1).

**Chapter One** introduces the thesis by defining the problem of poor dietary intake in children and explaining the current public health challenges. The chapter argues the importance of the ECEC setting, system-based approaches, and understanding of contextual factors in finding a solution.

In **Chapter Two** and **Chapter Three**, the existing literature on early childhood nutrition interventions is synthesised and systematically mapped to the novel Determinants of Nutrition and Eating (DONE) framework. The DONE framework provides a comprehensive framework of 441 factors influencing children's nutrition and eating categorised into 51 sub-categories across the individual, interpersonal, environmental and policy level (101). The findings from the scoping review are presented in two separate manuscripts and chapters in this thesis to allow for in-depth reporting of the results given that over 190 relevant studies were identified and included in the review. **Chapter Two** presents a map of the evidence quantifying interventions against the framework and comparing determinants addressed to the research priority ratings provided by the DONE framework. **Chapter Three** presents the outcomes from the interventions and identifies determinants which respond better to intervention to improve children's diets.

Findings from the scoping review showed that while most interventions were conducted in the ECEC setting, there were limited policy level interventions to support implementation and sustainability of evidence-based ECEC interventions. Given the importance of the ECEC setting in supporting healthy growth and development through nutrition, implementation challenges, and lack of policy level action, **Chapter Four** and **Chapter Five** explore the contextual factors influencing implementation of healthy eating policies and practices in the ECEC setting. Qualitative research methods were used as they allow for deeper understanding of the determinants and relationships within the ECEC setting and are useful for exploring system complexity (102). **Chapter Four** explores the perspectives of early childhood directors who play important roles in making decisions about educational program planning as well as managing resources to support operation of ECEC services. **Chapter Five** explores the perspectives of early childhood educators and cooks who play an important role in the delivery of healthy eating policies and practices. The Consolidated Framework for Implementation Research (CFIR) outlines key contextual determinants of implementation and was used to guide the qualitative research (103).

**Chapter Six** discusses and integrates the key research findings and their implications. Recommendations for future public health strategies and policies within and beyond the ECEC setting were suggested. Suggested future research is documented.

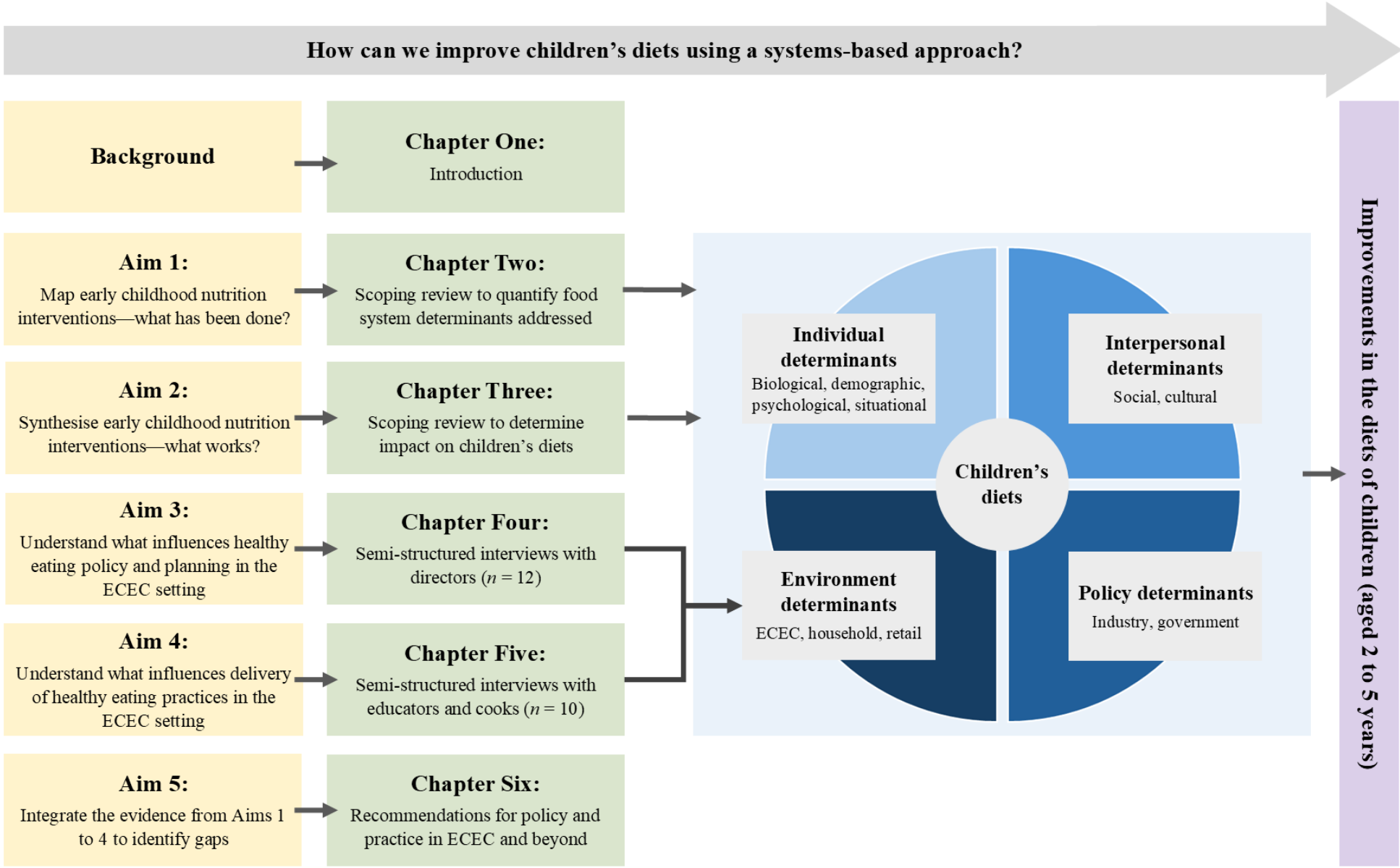


**Figure 1.1** Flow chart of thesis structure, outlining thesis aims, chapters, how they address system determinants and contribute to a systems-based approach to improve diets of children aged 2 to 5 years.

ECEC, early childhood education and care

## 1.7 Conclusion to chapter

Achieving optimal diets for young children under five years is a complex public health challenge. A systems-based approach is needed to enhance implementation success and sustainability of healthy eating interventions. The ECEC setting provides a powerful opportunity to reach and impact children's diets and eating behaviours, however, contextual factors may be inhibiting successful implementation and intended outcomes of evidence-based nutrition interventions. **Chapter Two** presents a published scoping review to map the evidence and identify leverage points to enhance system-based approaches to improving children's diets.

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# Chapter Two: Systems map of interventions to improve dietary behaviours of preschool children: a scoping review

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## 2.1 Publication details

The chapter is a reformatted version of the manuscript published in *Preventive Medicine* (see Appendix 3.1): Chan J, Conroy P, Phongsavan P, Raubenheimer D, Allman-Farinelli M. Systems map of interventions to improve dietary intake of pre-school aged children: A scoping review. Prev Med. 2023;177:107727. DOI:10.1016/j.ypmed.2023.107727

The layout, terminology and English language is in accordance with journal requirements. Referencing in this chapter has been changed to be consistent with Vancouver referencing style.

## 2.2 Author contributions

JC, PP, DR and MAF were involved in the conceptualisation and design of the study. JC led the data collection and analysis. JC and PC screened articles and extracted data, with assistance from MAF to resolve uncertainties. JC drafted the manuscript, and all authors were involved in review and editing of the final manuscript.

## 2.3 Introduction to chapter

Children's diets remain sub-optimal despite increasing attention to target early childhood and abundant evidence exploring the effectiveness of healthy eating interventions to improve children's diets. A systems-based approach is recommended to understand and address the complex determinants influencing children's diets and enhance sustained impact of healthy eating interventions. Given the large breadth of literature exploring healthy eating interventions in early childhood, it is important to synthesise the evidence to understand which areas are underexplored and where future research needs to be focused to ensure that all system-level determinants are addressed. In this chapter, a scoping review was conducted to map the evidence and quantify which determinants are most frequently addressed and identify which determinants are underexplored.

## 2.4 Abstract

Implementation and sustaining impact of early childhood nutrition interventions in practice remains a challenge. An understanding of the extent to which determinants across multiple levels of the food system are being addressed may improve success. This literature review aimed to synthesise the evidence on interventions targeting dietary intake and eating behaviours in preschool children using a systems approach.

Eligible studies included intervention studies targeting the dietary intake of preschool children aged 2–5 years in high income countries, published in English after January 2000. Interventions were categorised to the Determinants of Nutrition and Eating (DONE) framework for children developed and evaluated by experts across multiple fields. The framework maps and ranks 411 factors driving eating behaviours and nutrition and can be used to systematically summarise determinants. DONE ranks each determinant for its perceived research priority.

A total of 160 eligible studies were identified. Most interventions targeted interpersonal (*n* = 101, 63.1%) and individual (*n* = 85, 53.1%) level determinants, with fewer targeting environmental (*n* = 55, 34.4%) and policy level (*n* = 17, 10.6%) determinants. The most frequently addressed

determinants were Parental Resources and Risk Factors ($n$ = 85) and Children's Food Knowledge, Skills and Abilities ($n$ = 67). These determinants had a Moderate research priority rating. Home Food Availability and Accessibility at the environmental level is classified as the highest research priority, however, only 15 of 160 interventions addressed this determinant.

This review highlights home food availability and accessibility as potential leverage points for future interventions to improve children's dietary intake and eating behaviours.

**Keywords:** Child; Diet; Food environment; Food policy; Food system; Health Promotion; Preschool; Nutrition; Systems-approach

## 2.5 Introduction

Diet is a major risk factor for non-communicable diseases (NCDs). In 2017, dietary risk factors attributed to 11 million deaths and 255 million disability-adjusted life years globally (1). Diets high in sodium and low in wholegrains, fruits, nuts and seeds, and vegetables were among the leading risk factors globally (1, 2). Higher consumption of ultra-processed foods high in added sugar, saturated fat, sodium, and additives, is associated with increased risk of overweight and obesity, all-cause mortality, metabolic syndrome, and depression (3). There is a large body of evidence to demonstrate healthy eating habits and diets can reduce NCD burden (4, 5).

Establishing good nutrition in early childhood is critical for cognitive development (6) and long-term healthy eating behaviours and dietary patterns (7). An unhealthy diet in childhood is associated with rapid weight gain (8), increased risk of childhood obesity (9), and increased risk of obesity and cardiovascular disease in adulthood (10). The annual direct costs of childhood overweight and obesity is projected to be $13.52 billion (2022 United States Dollars) by 2050 (11). Investing in early childhood nutrition interventions can reduce economic costs from diet related NCDs (12). However, national health surveys show that overall diet quality of preschool children remains low in high income countries (HIC). In the United States of America (USA), the 2015-16 National Health and Nutrition Examination Survey showed that 39.8% of children aged 2-5 years had poor-quality diets

(13). In Australia, the 2017-18 Australian Health Survey showed that only 18.5% of children aged 2-3 years and 3.8% of children aged 4-8 years were meeting both fruit and vegetable recommendations (14).

As children reach preschool years, there is a rapid development of self-regulation skills, decreased reliance on parents and caregivers and increased capacity to make individual decisions involved in developing healthy diets (15). There have been many studies targeting children's diets during this critical developmental period with mixed results. A Cochrane systematic review of 80 interventions for increasing fruit and vegetable intake in children 0-5 years found that the quality of evidence and magnitude of effect remains limited (16). The evidence for the translation of early childhood nutrition interventions into sustainable real-world population level impact remains uncertain (16-18). As such, there has been increasing attention for whole system approaches that target the complex, multifactorial determinants influencing nutrition and eating (19).

The modern food systems in HIC have an abundance of highly-processed food which promotes excessive energy intake associated with overweight, obesity and NCDs (20). Food systems consider the interactions between the food supply chain, external and personal food environments, the behaviours of caregivers and children, and children's diets (21). A shift in the current food system is needed to address malnutrition and achieve the global nutrition targets as set by the United Nations Sustainable Development Goals (22, 23). A systems approach takes into consideration all levels of the food system to support children to achieve healthy and sustainable diets (20, 21). However, it remains unclear which determinants in the food system need to be prioritised.

This review aims to systematically map interventions targeting dietary intake in preschool aged children in HIC. This review will identify food system leverage points and guide the translation of systems approaches into policy and practice to improve early childhood nutrition. A scoping review approach is suitable for synthesising the large breadth of literature on early childhood nutrition and identifying knowledge gaps (24).

## 2.6 Methods

### *2.6.1 Protocol and registration*

The scoping review was conducted following the Joanna Briggs Institute (JBI) Methodology for Scoping Reviews (25). The results are reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for the scoping review process (Supplementary File 1). The review protocol was registered with the Open Science Framework on 25 July 2022 and updated on 14 April 2023 to outline changes in reporting of mapping outcomes separately (registration digital object identifier: https://doi.org/10.17605/OSF.IO/KP49E)

### *2.6.2 Eligibility criteria*

The eligibility criteria were determined using the Population, Concept and Context framework as defined by JBI (25).

The population of interest were preschool aged children. Studies were eligible for inclusion if they targeted children aged 2-5 years and/or stakeholders involved in food provision such as parents and caregivers, and early childhood education and care (ECEC) service staff. Children under 2 years were excluded due to different developmental stages and dietary requirements. Studies that only included children with clinical conditions were ineligible.

To be as comprehensive as possible, any study that examined the impact of a nutrition or multicomponent intervention on the dietary intake of preschool children were eligible. Studies were ineligible if children's dietary intake was not reported.

Eligible studies were limited to those conducted in HIC with modern food systems like Australia. HIC[1] were defined by World Bank classifications (26).

Experimental studies using randomised controlled trial (RCT), non-randomised controlled trial, and quasi-experimental study designs and analytical observational studies using cohort, case-control and

[1] High income countries defined as those in which 2024 Atlas Gross National Income per capita was greater than $13,935.

analytical cross-sectional study designs examining exposure to an intervention were eligible. Qualitative studies, reviews, unpublished manuscripts, conference abstracts, and studies that did not provide new data such as commentaries were ineligible.

### *2.6.3 Information sources and search strategy*

An initial limited scoping search was conducted on SCOPUS and MEDLINE to identify relevant peer-reviewed articles. Keywords in the title, abstract and subject headings were used to develop the search strategy in consultation with an experienced academic liaison librarian.

A full search was conducted across six electronic bibliographic databases (Scopus, Medline via Ovid, Embase via OvidSP, ERIC via OvidSP, Global Health via OvidSP, and The Cochrane Library) on 17 May 2022. The search strategy was adapted for use with each database (Supplementary File 2).

The search was limited to studies published in the English language and from January 2000 up to the date the searches were run. The cut-off date has been chosen to capture contemporary interventions relevant to current nutrition policy and practice and capture key interventions implemented in Australia identified in the initial scoping search.

### *2.6.4 Selection of sources of evidence*

Search results were uploaded into EndNote 20 and de-duplicated (27). Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia) was used for the screening process. Pilot testing of the eligibility criteria was performed on a random sample of 25 studies before commencing screening (25). Screening of title and abstracts against the eligibility criteria was performed by one reviewer (JC). Full texts for potentially relevant reports were retrieved and reviewed independently and in duplicate by two reviewers (JC, PC) against the eligibility criteria. Disagreements between screeners were resolved by consensus or by decision of a third researcher (MAF) if consensus was not reached. Reasons for exclusion of full-text reports were recorded against the eligibility criteria.

### *2.6.5 Data charting process and data items*

Data extraction was completed by one reviewer (JC) and 20% was cross-checked with a second reviewer (PC) using a pilot tested form. The data extracted and summarised included specific details about the article, aims/purpose, participants, methods, intervention, outcomes (as described in Concept section above) and the dietary determinants addressed.

### *2.6.6 Synthesis of results*

The Determinants of Nutrition and Eating (DONE) framework (28) was used to systematically organise determinants addressed in included studies. The DONE framework is an interdisciplinary framework of the factors driving food choice, eating behaviour and dietary intake. It was developed in a three-phase process by 87 members of the European research network, Determinants of Diet and Physical Activity, and 129 external experts (29). Determinants were identified and categorised into a framework through three Delphi consensus rounds. The framework was then evaluated, and determinants were rated on modifiability, relationship strength between determinants and food choice, eating behaviour and dietary intake outcomes, and population level effect of determinants on these outcomes. In the final phase, a pilot round of framework updating was conducted. The final framework includes 411 determinants, categorised by four main socio-ecological levels (policy, environment, interpersonal and individual), and further sorted by two additional layers including 11 stem-categories and 51 leaf-categories (29). The DONE framework provides an overall priority of research (OPR) score for each determinant on a scale of 1.00 (Low) to 3.00 (High), calculated by taking a weighted average of modifiability, relationship strength, and population-level effect scores (29).

For the synthesis of our results, studies were categorised by main socio-ecological levels, then stem-categories and leaf-categories. An average OPR score for each leaf category was calculated and assigned a DONE research priority rating of Low (mean OPR = 1.00-1.49), Moderate (mean OPR = 1.50-1.99), Substantial (mean OPR = 2.00-2.49) or High (mean OPR = 2.50-3.00). These categories were previously defined in the development of the DONE framework (29).

As the DONE framework was not designed specifically for the early childhood setting, we were unable to categorise the childcare food environment using existing framework determinants. '*Childcare food environment'* was added as an additional determinant for this review. This was categorised under the Environment Food Availability and Accessibility leaf category as part of the Meso/Macro Environment stem category similar to the existing determinant for school-aged children '*School canteen food environment'*. The childcare setting has been previously categorised in the Meso/Macro environment (23).

## 2.7 Results

A total of 32,566 records were identified from electronic database searches. After duplicate records were removed, the title and abstract of 21,369 records were screened and 1,066 full text reports were retrieved and assessed for eligibility. A final sample of 160 studies met eligibility criteria and were included in the review (Figure 2.1). Primary reasons for exclusion were ineligible study design (*n* = 309) and children's dietary intake not reported as an outcome (*n* = 287).

### *2.7.1 Characteristics of included studies*

The largest proportion of studies were conducted in the USA (*n* = 93, 58.1%), followed by Australia (*n* = 18, 11.3%), the United Kingdom (*n* = 11, 6.9%), Canada (*n* = 4, 2.5%), and Portugal (*n* = 4, 2.5%). There were 91 studies conducted in the ECEC setting (*n* = 91, 56.9%), 24 studies were conducted in the community setting (*n* = 25, 15.6%), 17 studies were home-based (*n* = 17, 10.6%), nine studies were federal programs (*n* = 9, 5.6%), eight studies were conducted online (Facebook, website or app) or by telephone (*n* = 8, 5%), five studies were conducted in the health care setting (*n* = 5, 3.1%), five studies were conducted across multiple settings (*n* = 5, 3.1%), and one study was conducted in the playgroup setting (*n* = 1, 1.6%). These studies are summarised in Sections 2.7.2 to 2.7.5.

Most studies targeted interpersonal (*n* = 101, 63.1%) and individual (*n* = 85, 53.1%) level determinants, with fewer targeting environmental (*n* = 55, 34.4%) and policy level (*n* = 17, 10.6%)

determinants (Figure 2.2). Most interventions addressed one socioecological level ($n$ = 75, 46.9%) or two levels ($n$ = 70, 43.8%). Fewer studies targeted combined individual, interpersonal and environment level strategies ($n$ = 13, 8.1%). Only one study ($n$ = 1, 0.6%) included strategies that targeted determinants across all 4 levels. DONE framework categories for each included study is available in Supplementary File 3. A summary of the included studies by DONE framework is presented below.

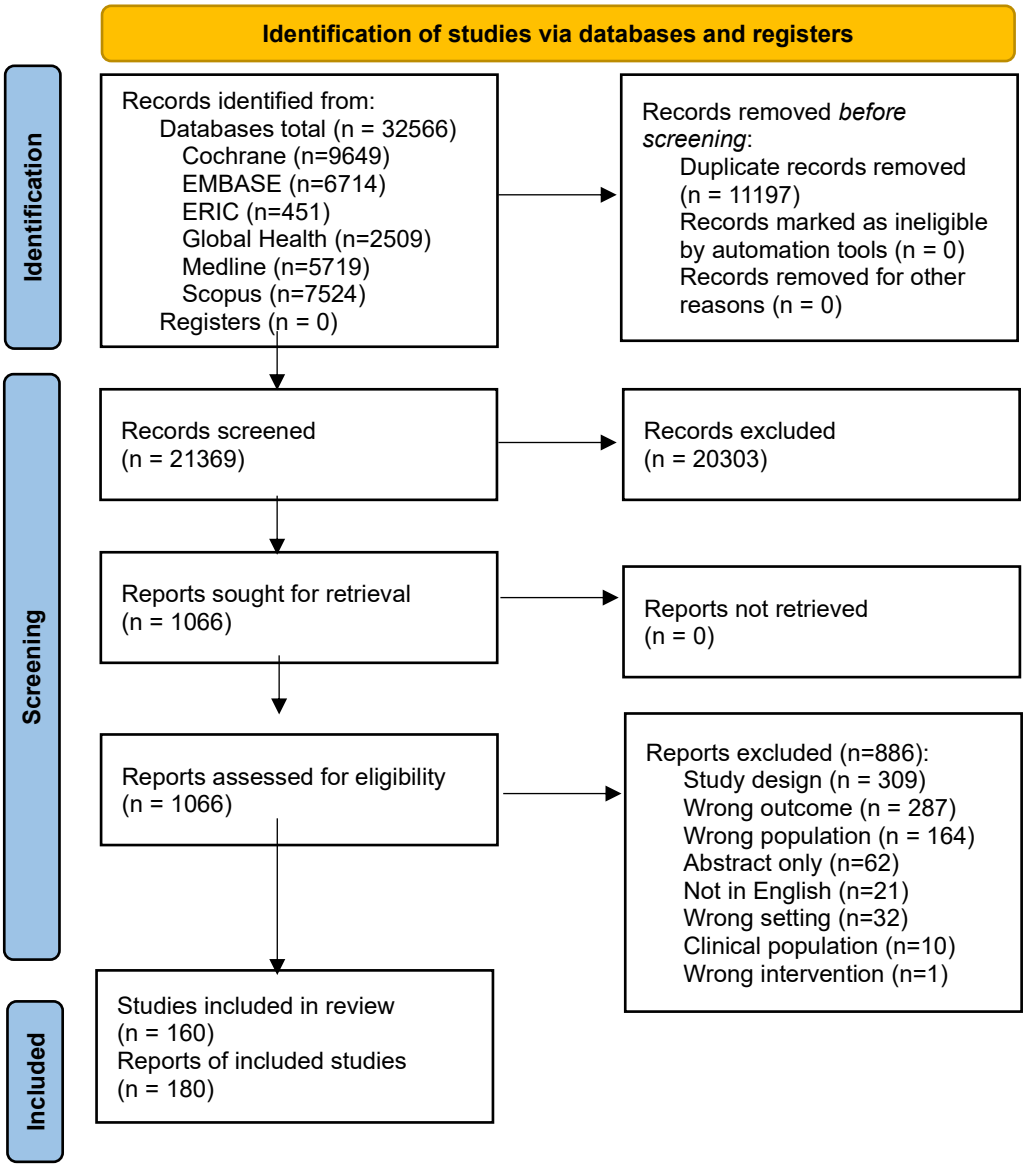


**Figure 2.1** Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) 2020 flow diagram for new systematic reviews which included databases and registers only. The flow diagram has been used as recommended by the PRISMA extension for scoping reviews.

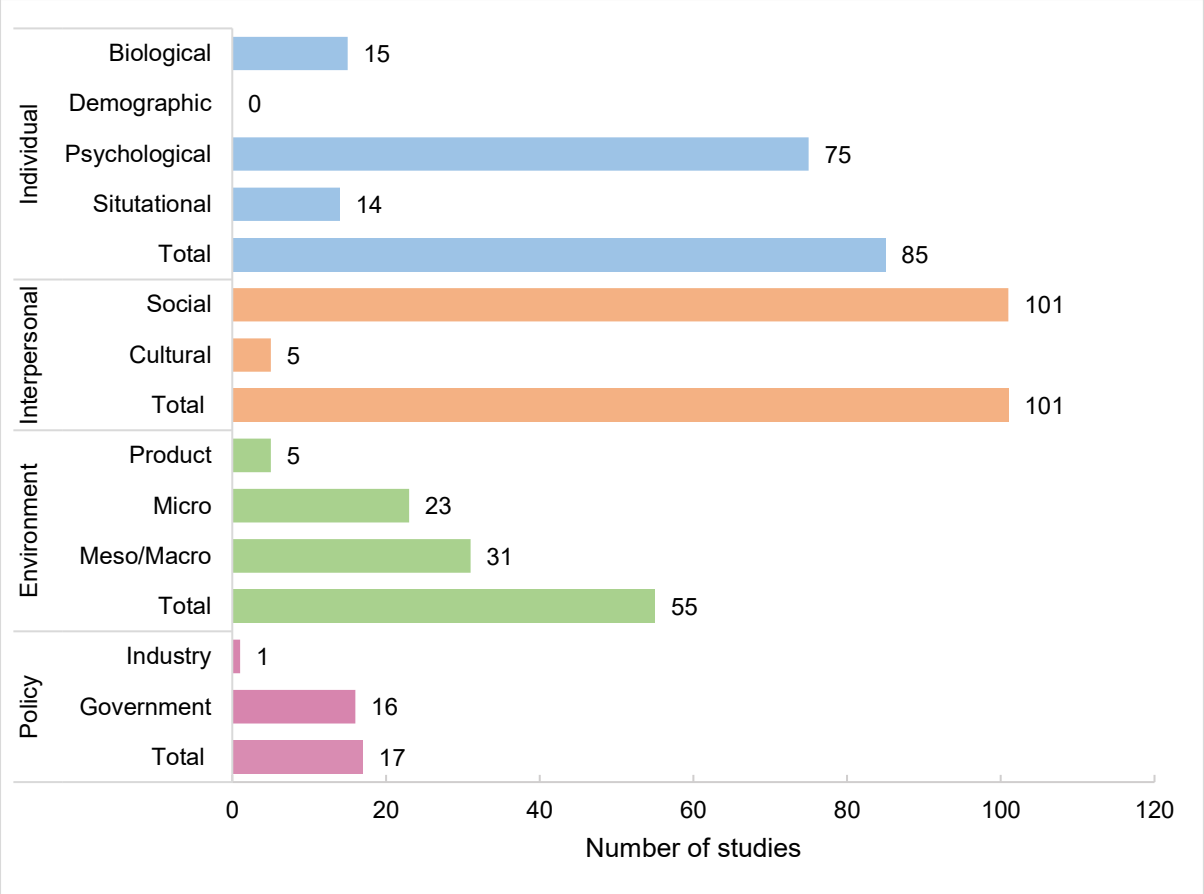


**Figure 2.2**. Number of studies ($n$ = 160) targeting stem level categories and main level socioecological categories (total[1]) of the Determinants of Nutrition and Eating framework.

[1] Total number may not equal sum of stem level and/or main level categories as studies may target multiple stem level categories and across multiple main level categories.

### *2.7.2 Individual level*

Of the 85 studies that targeted individual level determinants, 59 studies included interventions to address determinants across multiple socio-ecological levels. Most studies addressed psychological category determinants ($n$ = 75), followed by biological determinants ($n$ = 15) and situational determinants ($n$ = 14). No studies addressed demographic category determinants (Table 2.1).

**Table 2.1.** Number of studies and average Determinants of Nutrition and Eating (DONE) framework research priority score per stem and leaf category at the Individual level

| Leaf category | Example determinants | Research priority[1] | n (studies) |
|---|---|---|---|
| **Biological** | | | |
| **Food-Related Physiology** | genetic nutrient intolerances, appetite, food allergies, taste sensitivity, obesity-associated genes, gut microbiota | 1.79 | 0 |
| **Anthropometrics** | BMI, body composition, birth weight | 1.61 | 0 |
| **Sensory Perception** | food preferences, taste aversions, food liking, food wanting, fat liking, learned taste preferences, biological taste preferences | 2.11 | 15 |
| **Physical Health** | mental health status, health status, chronic diseases, prematurity | 1.71 | 0 |
| **Sleep Characteristics** | sleep duration, sleep difficulties | 1.55 | 0 |
| **Demographic** | | | |
| **Biological Demographics** | having been breastfed, sex, age | 1.69 | 0 |
| **Cultural Characteristics** | religion, nationality, ethnicity | 1.67 | 0 |
| **Personal Socio-Economic Status** | socio-economic status | 1.64 | 0 |
| **Situational Demographics** | place of residence | 1.82 | 0 |
| **Psychological** | | | |
| **Personality** | self-efficacy, distractibility when eating, personality / temperament | 1.89 | 0 |
| **Mood And Emotions** | wellbeing, positive emotions, negative emotions, mood | 1.78 | 1 |
| **Self-Regulation** | self-regulation skills, self-control, emotion suppression, impulsivity, executive functioning | 1.86 | 3 |
| **Health Cognitions[2]** | previous experience with disease | N/A | 0 |
| **Food Knowledge, Skills and Abilities** | food familiarity, food memories | 1.82 | 67 |
| **Food Habits** | habitual eating, past eating behaviour | 1.92 | 1 |
| **Food Beliefs** | food involvement, food enjoyment, | 2.13 | 30 |
| **Eating Regulation** | external eating, neophobia, food selectivity, emotional eating, variety seeking, intuitive eating | 1.78 | 8 |
| **Weight Control Cognitions and Behaviours** | eating in the absence of hunger, disinhibition | 1.98 | 1 |
| **Situational** | | | |
| **Hunger** | satiation, food deprivation, hunger | 2.22 | 1 |
| **Related health Behaviours** | frequency of television viewing, physical activity level | 2.28 | 13 |
| **Situational And Time Constraints** | daily rhythm/structure, parental access to a car | 1.64 | 0 |

[1] An average research priority rating (maximum score = 3.00) was calculated for each leaf category by taking the mean of the Overall Priority for Research (OPR) scores assigned to determinants within the DONE framework. Low (mean OPR = 1.00-1.49), Moderate (mean OPR = 1.50-1.99), Substantial (mean OPR = 2.00-2.49) or High (mean OPR = 2.50-3.00).

[2] No OPR score available from the DONE framework.

*Biological*

All studies that addressed biological determinants included children's sensory perception. Most studies examined associations between repeated exposure strategies and vegetable liking and preference (30-33). Studies also combined repeated exposure with a familiar or liked food (flavour-flavour learning) (34-38) or reward (37, 39, 40). Other interventions examined associations between sensory play (41, 42) and offering food in different shapes and liking and wanting of vegetables and healthy snacks (36, 43).

*Demographic*

There were no studies that addressed demographic determinants (Table 2.1).

*Psychological*

Most studies in the psychological stem category addressed children's Food Knowledge, Skills and Abilities ($n$ = 67). Interventions included classroom-based activities with children such as taste testing, games, song, and activity sheets (30, 32, 39, 44-80), four studies specifically used storybooks (41, 81-83) and one study involved a puppet show for children (84). Other strategies included parent and child nutrition education sessions (85-104) and two studies involved family nutrition education sessions via home visits (105, 106).

Interventions from thirty studies were categorised into Food Beliefs. Many studies aimed to influence food belief determinants through food preparation and cooking activities with children and/or parents (56, 59, 63, 65-67, 71, 77, 78, 80, 89, 93, 94, 97, 99, 102, 104, 105, 107-109), taste testing (30, 54, 57, 59, 61, 65-68, 74, 76, 77), and gardening activities (67, 74, 102). Some studies aimed to influence children's thoughts and beliefs about healthy foods using characters and story such as mascots, puppets and role playing (75, 77, 80, 84).

Fourteen studies addressed Eating Regulation. Interventions investigated repeated exposure and vegetable neophobia (31, 71, 110), exposure to a variety of fruits and vegetables (110, 111), mindful eating activities and group meals (56, 112) and nutrition education on hunger and fullness cues (104).

External cues to encourage consumption of healthy foods included use of nutrition phrases during meal times (31) and plate design with sections for fruit and vegetables (66).

Of the three studies that addressed Self-Regulation, two preschool programs promoted self-regulation skills via problem solving and behaviour change activities (63) and breathing sessions (98). One intervention targeted self-regulation, responsive feeding and sensitive parenting via home visit lessons (108). One study addressed Mood and Emotions, targeting children's mental wellbeing through classroom modules (103). One study specifically addressed Food Habits via a nursery health promotion campaign to encourage children to eat vegetables as the first bite of meals (113). One study addressed Weight Control Cognitions and Behaviours, examining the impact of gardening program on eating in the absence of hunger among children (61).

*Situational*

Thirteen studies included strategies to address children's physical activity levels and were mapped to the Related Health Behaviours leaf category (50-52, 57, 79, 85-88, 90, 95, 114, 115). One study assessed carbohydrate digestion rates on satiety (116).

### *2.7.3 Interpersonal level*

Of the 101 interpersonal level studies, 68 were multi-level. All studies ($n$ = 101) addressed social determinants and five studies considered cultural determinants (Table 2.2).

*Social*

Most studies addressed social leaf-category determinants related to Parental Resources and Risk Factors ($n$ = 85). Thirty-nine studies investigated in-person nutrition education sessions and parental nutritional knowledge and some included a parental homework component (49, 56, 62, 63, 69-71, 79, 86-91, 93-95, 98-105, 109, 117-129). Twelve studies delivered nutrition education via telephone support calls, online modules or sessions, or an app (130-141). Twenty-three studies aimed to improve parental nutrition knowledge through provision of parent communication resources including written information on handouts, newsletters, flyers, posters, tip cards, health reports, resource folder, backpack, and through compact disks (44, 47, 48, 50-52, 54, 57, 60, 61, 64, 65, 74, 76, 78, 80, 83, 84,

142-146). Four studies delivered information via text messaging, Facebook or website only (62, 131, 147, 148). Five studies provided clinic-based brief parental intervention (55, 121, 149-151) and three studies delivered education via home-visits (63, 106, 152). One program assessed the effect of a nutrition education program for preschool children on parental nutrition knowledge (59).

Parental Behaviour was addressed in 52 studies. Frequently used strategies included home based tasks or home visits involving goal setting, feedback and self-monitoring of behaviour (54, 56, 63, 70, 75, 85, 95, 98, 102, 105, 106, 125, 128, 129, 136, 144, 152-154), skill-building workshops (62, 69, 71, 86, 89, 94, 95, 99, 120, 121, 127-130, 134, 155, 156), cooking classes (44, 63, 89, 93, 97, 99, 117, 124, 145), and nutrition counselling and motivational interviewing (55, 90, 118, 132, 133, 138, 141, 143, 154, 157). Other strategies included written materials such as handouts or facebook posts (75, 135, 142, 148) and community activities (87).

Parental Feeding Styles determinants were addressed by 25 studies. Interventions included group education sessions (56, 91, 93-95, 102, 120, 122, 123, 127-129, 134, 155), home based activities such as home visits, telephone calls, goal setting, and written materials (37, 40, 108, 132, 139, 141, 142, 152) and online support via Facebook groups (62, 133, 145).

Parental Attitudes and Beliefs determinants were addressed by 25 studies. Interventions included group education and homework activities (49, 70, 71, 95, 99, 122, 123, 125), posters (127, 143), and nutrition counselling, goal setting and provision of health reports (95, 118, 125, 126, 138, 140, 142, 143, 150, 151, 154).

Family Food Culture determinants were addressed by 11 studies. All intervention included food preparation and cooking, or family activities such as group dinners, and handouts with cooking or gardening instructions (67, 87, 94, 99, 102, 105, 108, 109, 124, 132, 142).

Social Support determinants were addressed by nine studies. Diet and eating related support at the community level was embedded in interventions through referrals to community resources (105, 121) and community health promotion social marketing campaigns (58, 113, 114). Parental social support

was provided through Facebook groups and in-person meetings for parents to discuss and share experiences (62, 95, 133, 157).

Social Influence determinants were addressed by eight studies. Four studies included ECEC service staff role modelling as a strategy (68, 69, 76, 79, 145). Two studies used videos, storybooks or puppets to role model target behaviours (76, 158). Other interventions included videos of other preschool children eating (159) and cooking and eating meals together in groups of children, teachers and parents (89).

One study addressed Family Structure examining the impact of program to promote parent-child interactions and connectedness to support cohesion, healthy diet and lifestyle behaviours (155). No studies addressed Household Socio-Economic Status.

*Cultural*

Five studies addressed Cultural Cognitions. All involved culturally tailored programs (49, 70, 79, 87, 106) and three were delivered by cultural health educators (49, 70, 87). No studies addressed Cultural Behaviour.

### *2.7.4 Environment level*

Of the 54 environmental level studies, 40 were multilevel studies, 31 studies targeted the meso/macro environment, 23 studies targeted the micro-environment and five studies addressed product attributes (Table 2.3).

*Product*

Of the five studies in this stem category, all addressed Intrinsic Product Attributes. Studies aimed to reduce energy density of foods through increasing proportion of fruit and vegetables in meals and snacks served (160-163) and replacing meals with soy-enhanced lunches (164). No studies addressed Extrinsic Product Attributes.

**Table 2.2.** Number of studies and average Determinants of Nutrition and Eating (DONE) framework research priority score per stem and leaf category at the Interpersonal level

| Leaf category | Example determinants | Research priority[1] | n (studies) |
|---|---|---|---|
| **Social** | | | |
| **Family Structure** | household size, family cohesion, family composition | 1.43 | 1 |
| **Family Food Culture** | family food culture, household food processing (cooking), family preferences, household food production (growing) | 1.89 | 11 |
| **Household Socio-Economic Status** | parental food insecurity, household food security, low parental income parental educational level, household income, household socio-economic status, household budget constraints, parental income, parental occupation | 1.73 | 0 |
| **Social Influence** | peer modelling, eating occasion, social norms | 2.18 | 9 |
| **Social Support** | parental recommendations, social support, community recommendations | 2.12 | 9 |
| **Parental Resources and Risk Factors** | parental nutrition knowledge, parental food market knowledge, parental food product knowledge, parental time constraints, parental depression | 1.99 | 85 |
| **Parental Attitudes and Beliefs** | parental weight control concerns, parental perception of child's weight, parental perceived food safety, parental weight control goal, parental lay food theories, parental trust in food labelling, parental trust in food producers, parental food ethics, parental food risk aversion, parental willingness-to-pay, parental trust in food certification, parental trust in food distribution, parental body dissatisfaction | 1.80 | 25 |
| **Parental Behaviors** | parental modelling, parental food habits parental food processing (cooking), parental lifestyle, parental smart shopping, parental frugality, parental food production (growing) | 2.01 | 52 |
| **Parental Feeding Styles** | early exposure, parental portion size habits, food used as incentive, parental food restriction, parental pressure-to-eat, parental instrumental feeding, parental emotional feeding | 2.15 | 25 |
| **Cultural** | | | |
| **Cultural Cognitions** | cultural beliefs, cultural values, cultural norms | 2.06 | 5 |
| **Cultural Behaviours** | cultural food customs, cultural traditions, religious rituals | 1.92 | 0 |

[1] An average research priority rating (maximum score = 3.00) was calculated for each leaf category by taking the mean of the Overall Priority for Research (OPR) scores assigned to determinants within the DONE framework. Low (mean OPR = 1.00-1.49), Moderate (mean OPR = 1.50-1.99), Substantial (mean OPR = 2.00-2.49) or High (mean OPR = 2.50-3.00).

*Micro*

Within the micro-environment, most studies addressed determinants related to Home Food Availability and Accessibility ($n$ = 15). There were eight studies investigating the United States Department of Agriculture Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and home availability and accessibility of healthy foods (107, 165-171). The WIC program provides healthy food packages, information on healthy eating and breastfeeding, and referrals to health care and social services for eligible low-income households (171). Other interventions included online websites and/or telephone calls with health professionals (141, 147), farmers market coupons (172) and combination of family activities, provision of resources/equipment and newsletters aimed at improving home food availability and accessibility (98, 124, 145, 152).

The eating environment was addressed in five studies. Two studies encouraged or incentivised parents to implement behaviour changes (54, 142). Other strategies included home visits (121), motivational interviewing calls (132) and resources such as newsletters, tip cards, posters (48).

Of the three studies addressing Portion Size, two were conducted in the preschool setting (111, 173) and one study was conducted in the home setting (162), examining the effects of increasing portion size of fruit and vegetables on consumption and energy intake.

*Meso/Macro*

All Meso/Macro category studies targeted Environment Food Availability and Accessibility ($n$ = 31) and were conducted in the childcare setting (44, 47, 48, 53, 54, 58, 67-70, 73, 76, 103, 104, 114, 145, 146, 174-187). Interventions included modification of centre menus, development of nutrition policies, support to enhance implementation of best practice, centre staff training, implementation of gardens, and provision of kitchen equipment. One study addressed Social Initiative determinants through increasing organisational capacity of non-government organisations (NGOs) (114).

**Table 2.3.** Number of studies and average Determinants of Nutrition and Eating (DONE) framework research priority score per stem and leaf category at the Environmental level

| Leaf category | Example determinants | Research priority[1] | n (studies) |
|---|---|---|---|
| **Product** | | | |
| Intrinsic Product Attributes | product taste, product texture, product sensory properties, product flavour | 2.13 | 5 |
| Extrinsic Product Attributes | product package size, package size, product appearance, package colour, product variety, product packaging, food labelling | 2.23 | 0 |
| **Micro** | | | |
| Portion Size | portion size | 2.41 | 3 |
| Home Food Availability and Accessibility | food accessibility, food availability | 2.64 | 15 |
| Eating Environment | meal environment | 2.21 | 5 |
| **Meso/Macro** | | | |
| Natural Conditions | time of day, season, weather | 1.49 | 0 |
| Characteristics Of Living Area | area deprivation, degree of urbanization | 1.58 | 0 |
| Environment Food Availability and Accessibility | ECEC food environment | N/A | 31 |
| Societal Initiatives | food-related NGO activity | 1.67 | 1 |

[1] An average research priority rating (maximum score = 3.00) was calculated for each leaf category by taking the mean of the Overall Priority for Research (OPR) scores assigned to determinants within the DONE framework. Low (mean OPR = 1.00-1.49), Moderate (mean OPR = 1.50-1.99), Substantial (mean OPR = 2.00-2.49) or High (mean OPR = 2.50-3.00).

### *2.7.5 Policy level*

Of the 17 policy studies, 16 were multi-level studies. Majority of these studies addressed Government determinants ($n$ = 16). Only one study addressed Industry determinants (Table 2.4).

*Government*

Studies addressing Government Regulation were primarily from USA federal programs that provide subsidies for healthy food aimed to improve food insecurity in low-income households ($n$ = 14). Nine studies investigated the United States Department of Agriculture WIC program and children's dietary intake (107, 165-172). Three studies examined the Child and Adult Care Food Program (CACFP), a federal USA program that provides re-imbursements for meals and snacks for children from low-income households enrolled in childcare centres (174, 179, 180). Other Government Regulation

determinants addressed include dietary guidelines in ECECs in South Carolina (186) and food advertisement regulations in Chile (188).

Of the two studies that addressed Government Campaign determinants, one study assessed an educational social marketing campaign for healthy food conducted in the United Kingdom (189) and one study assessed the efficacy of a nutrition award scheme program promoting healthy eating conducted in long day care centres in Australia (175).

*Industry*

Only one study addressed Industry Influence. This study examined lobbying action in a multilevel community trial in the USA-Affiliated Pacific region aiming to reduce sugar-sweetened beverages and increase water intake (58). No studies addressed Industry Regulations.

**Table 2.4.** Number of studies and average Determinants of Nutrition and Eating (DONE) framework research priority score per stem and leaf category at the Policy level

| Leaf category | Example determinants | Research priority[1] | n (studies) |
|---|---|---|---|
| **Industry** | | | |
| Industry Regulations | portion size regulations, food nutritional composition regulations, nutritional composition guidelines | 2.18 | 0 |
| Industry Influence | lobbying | 2.04 | 1 |
| **Government** | | | |
| Governmental Regulations | food advertisement regulations, subsidies for healthy foods, nutrition labeling regulations, market regulations, food label regulations food advertisement bans | 2.03 | 14 |
| Campaigns | programs promoting healthy eating, programs discouraging unhealthy eating, educational campaigns for healthy food | 2.18 | 2 |

[1] An average research priority rating (maximum score = 3.00) was calculated for each leaf category by taking the mean of the Overall Priority for Research (OPR) scores assigned to determinants within the DONE framework. Low (mean OPR = 1.00-1.49), Moderate (mean OPR = 1.50-1.99), Substantial (mean OPR = 2.00-2.49) or High (mean OPR = 2.50-3.00).

### *2.7.6 Research priorities*

Studies most frequently targeted determinants of "Moderate" research priority, which were addressed 203 times, and determinants of "Substantial" research priority which were addressed 189 times (Figure 2.3). 'Substantial' determinants that were addressed by less than 10 studies included Hunger (Individual), Social Influence (Interpersonal), Social Support (Interpersonal), Cultural Cognitions (Interpersonal), Intrinsic Product Attributes (Environment), Extrinsic Product Attributes (Environment), Portion Size (Environment), Eating Environment (Environment), Industry Regulations (Policy), Industry Influence (Policy), and Government Campaigns (Policy). Home Food Availability and Accessibility was the only determinant with an average OPR rating of "High" and was addressed by 15 studies. Determinants of "Low" research priority were addressed once.

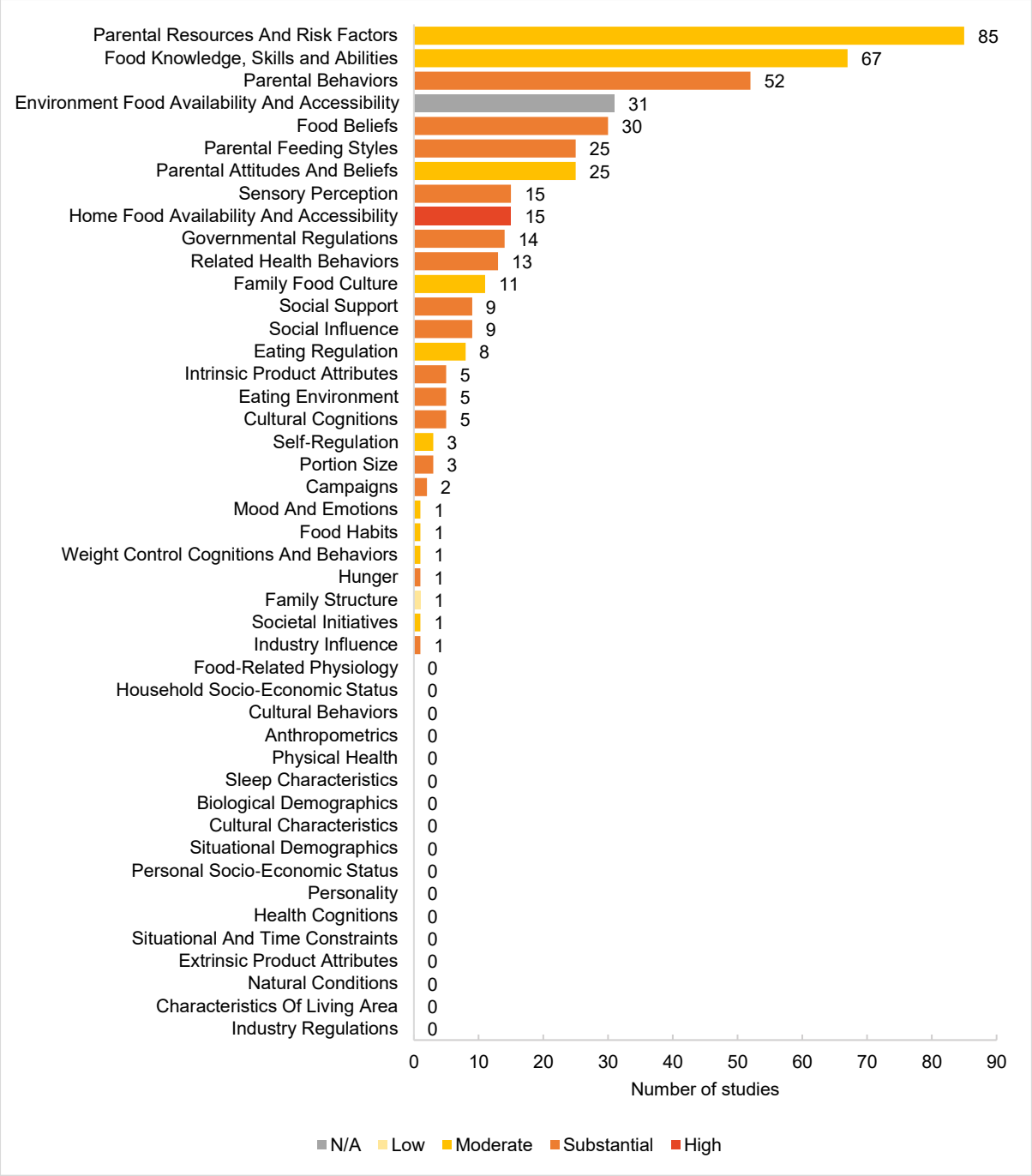


**Figure 2.3.** Number of studies targeting Determinants of Nutrition and Eating (DONE) framework leaf categories and classified by average Overall Priority Research (OPR) ratings. OPR ratings for each leaf category were averaged and classified into low (mean OPR = 1.00-1.49), moderate (mean OPR = 1.50-1.99), substantial (mean OPR = 2.00-2.49) and high (mean OPR = 2.50-3.00) research priority categories. Mean OPR rating for *Environment Food Availability and Accessibility* was not available due to the additional *"Childcare food environment"* factor included in this study by authors. Leaf categories with no studies were classified in the following OPR categories: Substantial (Extrinsic

Product Attributes, Industry Regulations), Moderate (Food-Related Physiology, Household Socio-Economic Status, Cultural Behaviours, Anthropometrics, Physical Health, Sleep Characteristics, Biological Demographics, Cultural Characteristics, Situational Demographics, Personal Socio-Economic Status, Personality, Situational and Time Constraints, Characteristics of Living Area), Low (Natural Conditions). No OPR rating was available from the DONE framework for Health Cognitions.

## 2.8 Discussion

This review systematically mapped the evidence on early childhood nutrition interventions using the comprehensive DONE framework to understand the extent to which determinants across multiple levels of the food system are being addressed. There was a paucity of multilevel studies, with most studies addressing only one or two socio-ecological levels. Most of the included studies focused on interventions targeting individual and interpersonal level determinants. Fewer studies focused on environment and policy level determinants, despite mostly 'Substantial' to 'High' research priority ratings of these determinants.

At the individual and interpersonal level, child and parental nutrition knowledge and skills were most frequently addressed, which had a 'Moderate' research priority rating. In addition to targeting knowledge and skills, future research addressing more 'Substantial' determinants including children's sensory perceptions, children's food beliefs, parental behaviours and feeding styles, and social influence and support is warranted. Individual and interpersonal determinants have been considered as more modifiable and feasible to implement compared to interventions targeting broader system determinants (190). As such, they are often the focus of early childhood nutrition interventions (191, 192). However, the efficacy of these interventions may be limited without cohesive action across multiple levels to support behaviour change in parents and children (193). Factors influencing children's eating behaviours are interconnected and involve a range of stakeholders, settings and sectors. Evidence suggests multicomponent interventions such as combining parent education with

changes in ECEC policy, were more likely to increase fruit and vegetable consumption in children under 5 years of age (16).

Further environment and policy action is needed to ensure the success of sustained behaviour change interventions (194, 195). While there have been evidence-based recommendations for systems approaches for nutrition and obesity interventions over the past two decades (190), this review identified determinants at the environment and policy level remain understudied. Key priorities include intrinsic and extrinsic food product attributes, portion size, children's eating environment, both industry and government regulation and influence. Home food availability and accessibility was also identified as a critical but understudied determinant and provides a potential leverage point for future interventions to improve children's dietary intake. Studies have shown home availability of healthy foods is associated with increased fruit and vegetable intake in children (196). Addressing home food availability and accessibility may be particularly beneficial for low socioeconomic households where ability to purchase healthy foods is limited by income (194). Evidence shows that children with parents who were socially disadvantaged were more likely to be affected by overweight or obesity in mid-adolescence (197).

The childcare food environment also plays a critical role in establishing children's eating behaviours and diets and requires further exploration. While there was no DONE research priority rating for this determinant, evidence suggests that this is an important setting for children. Centre-based childcare services provide extensive reach to young children and provide up to 67% of the daily recommended intake of energy and nutrients, making this setting a valuable intervention target for promotion of healthy eating (198). Systematic reviews demonstrate that interventions promoting healthy eating in the childcare setting can improve children's dietary intake and food choices (18). However, sustained implementation of nutrition interventions in this setting is complex, influenced by a number of factors and stakeholders, and remains a challenge (199). Further research to understand the determinants in the childcare food environment is recommended.

In addition to addressing children's food environment, there needs to be complementary policies and partnerships with sectors beyond the health domain to support the success of public health strategies.

At the policy level, there was some government action, primarily through subsidies for healthy foods in the USA. However, higher level legislative regulations and actions were lacking, notably in relation to industry influence and regulations. A study mapping healthy eating and active living policy implementation in New South Wales, Australia revealed that while there has been implementation of setting specific policies and programs in ECECs and schools, there was insufficient commitment for action targeting the wider food environment (200).

There are several barriers to policy level and food system changes to support healthy diets for children. Swinburn et al. argues that industry opposition, insufficient public demand, and government reluctance to translate policy recommendations into action has limited the success of food system shifts (23). Government and policy level changes are highly contested and challenging. Thus, the health sector reverts to supporting families to make informed choices rather than environmental and policy changes. Limiting factors include culture, ownership, and limited collaborative infrastructure across social, healthcare, and political systems to support changes in the food system (200). Furthermore, evidence for environmental and policy changes may be limited due to inadequate measures to capture the associations between food environments and health outcomes (201).

*Strengths and Limitations*

A strength of this review is the broad "birds eye view" provided by the scoping review methodology (24). This bigger picture approach is critical when looking at food systems to understand the intervention action across multiple levels and domains. The scoping review aimed to capture all published interventions inclusive of experimental and observational analytic studies, however, due to the large number of studies identified the search was limited to peer-review literature and did not include grey literature. A limitation is that study designs other than RCTs may be subject to confounding and raise questions about the robustness of results.

A further limitation of the literature and traditional analysis methods means that while there were more environmental and policy level interventions identified from the search, these studies were excluded as they did not directly measure effect on children's dietary intake.

Another strength of the review is that it systematically synthesised the literature using the comprehensive DONE framework evaluated by experts across multiple fields. The DONE framework helped to summarise the large breadth of evidence in early childhood nutrition and map priorities for future research. A strength of the DONE framework is that it was designed to be dynamic and allow for the addition of new determinants and ratings as understanding changes. In the third phase of the framework development, a pilot round of framework updating was conducted and resulted in the addition of nine new determinants (29). Recent studies indicate that environment and policy determinants such as food availability and accessibility continue to be critical drivers (16, 192, 194), which has not changed since the DONE framework was last updated in 2017.

However, a limitation of using a novel and dynamic framework is that it may not capture all determinants. The framework may oversimplify the many variables affecting nutrition and may not capture the nuances that may exist in different settings due to environmental influences. For example, the applicability of the DONE framework and research priority ratings in the early childhood setting needs further evaluation. As highlighted by this review, determinants related to the early childhood education and care setting could not be adequately categorised using existing framework categories and we added a category to overcome this. Continued updates are needed to ensure the framework reflects the most recent evidence in nutrition and eating research. For future interventions, we recommend conducting formative research to understand how environmental factors influence which determinants need to be prioritised in each setting.

## 2.9 Conclusion

To improve the success of early childhood nutrition interventions, a systems approach involving a set of complementary interventions targeting multiple determinants across all socioecological domains is needed. Most interventions target only one or two socioecological domains. Individual and interpersonal level determinants were most frequently addressed in the literature and interventions targeting environmental and policy level determinants were understudied. Environmental and policy

changes are needed to support the implementation behaviour change strategies aimed at children and parents and sustain improved dietary outcomes. Findings from this review suggest strategies to improve home food availability and accessibility as part of a set of multilevel actions could improve the success of early childhood nutrition interventions.

## 2.10 Conclusion to chapter

A systems approach recognises that improving dietary outcomes requires multi-level action to address the complex set of factors influencing children's diets. This scoping review synthesised the evidence on early childhood nutrition interventions and identified the determinants these interventions addressed. This was the first scoping review to apply the novel DONE framework to the ECEC setting. Findings from this review highlight the need to add a category specific to the ECEC setting and to further evaluate determinants and research priority ratings relevant to this setting. The DONE framework, which includes over 400 determinants, 51 stem categories, and 11 leaf categories, enabled a more detailed and comprehensive mapping of studies compared with other approaches, such as the Social Ecological Model, which typically uses broader categories. There is abundant evidence exploring interventions on improving children's diets, with most interventions addressing individual and interpersonal level determinants. Research gaps remain to address environmental and policy level determinants. Greater emphasis on children's food environments including the ECEC setting, home food availability and accessibility, and the wider food environment is warranted. Furthermore, more evidence is needed on the impact of industry and government regulation and influence in shifting the system to ensure long-term, population level improvements in children's diets. While we quantified frequently addressed and understudied determinants, it is important to explore whether interventions targeting these determinants positively influence children's diets. **Chapter Three** evaluates the impact of interventions included in Chapter Two to identify leverage points in the system for future intervention.

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## 2.12 Supplementary data

### Supplementary File 1

**Table S2.1.** Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a scoping review. | 1 |
| **ABSTRACT** | | | |
| Structured summary | 2 | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | 1 |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | 2-3 |
| Objectives | 4 | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | 2-3 |
| **METHODS** | | | |
| Protocol and registration | 5 | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | 3 |
| Eligibility criteria | 6 | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | 3 |
| Information sources* | 7 | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | 4 |
| Search | 8 | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | Supplementary file 2 |
| Selection of sources of evidence† | 9 | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. | 4 |
| Data charting process‡ | 10 | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | 4 |
| Data items | 11 | List and define all variables for which data were sought and any assumptions and simplifications | 4 |

| | | | |
|---|---|---|---|
| | | made. | |
| Critical appraisal of individual sources of evidence§ | 12 | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | N/A |
| Synthesis of results | 13 | Describe the methods of handling and summarizing the data that were charted. | 4-5 |
| **RESULTS** | | | |
| Selection of sources of evidence | 14 | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | 5-6 |
| Characteristics of sources of evidence | 15 | For each source of evidence, present characteristics for which data were charted and provide the citations. | 6-7 |
| Critical appraisal within sources of evidence | 16 | If done, present data on critical appraisal of included sources of evidence (see item 12). | N/A |
| Results of individual sources of evidence | 17 | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | Supplementary file 3 |
| Synthesis of results | 18 | Summarize and/or present the charting results as they relate to the review questions and objectives. | 7-19 |
| **DISCUSSION** | | | |
| Summary of evidence | 19 | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | 20 |
| Limitations | 20 | Discuss the limitations of the scoping review process. | 21-22 |
| Conclusions | 21 | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | 22 |
| **FUNDING** | | | |
| Funding | 22 | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | 23 |

1.9 JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

1.10* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

1.11† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

*1.12*‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

1.13§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

**Supplementary File 2**

**Table S2.2.** Search strategy as run on 17 May 2022

**Scopus**

| Search # | Search terms | Number of results |
|---|---|---|
| 1 | ( TITLE-ABS-KEY ( toddler* OR preschool* OR pre-school* OR childcare* OR child-care* OR "early childhood" OR "age* 2-5" OR daycare OR day-care ) AND TITLE-ABS-KEY ( ( health* OR diet* OR nutrition* OR food* OR lifestyle* ) W/3 ( therapy* OR guideline* OR policy* OR policies* OR interven* OR strateg* OR promot* OR educat* OR program* OR counsel* OR coach* OR "behavio?r change" ) ) AND TITLE-ABS-KEY ( ( diet* W/2 ( quality OR intake* OR behavior* OR behaviour* OR pattern ) ) OR ( nutrition* W/2 ( behaviour* OR behavior* OR status* OR knowledg* OR skill* ) ) OR ( food* W/2 ( pattern* OR habit* OR quality* OR frequenc* OR preferenc* OR knowledg* OR skill* OR belief* OR attitude* OR provision* ) ) OR ( ( feeding* OR eating* ) W/2 ( habit* OR practic* OR pattern* ) ) ) ) AND PUBYEAR > 1999 | 7,524 |

**Medline (via OvidSP)**

| Search # | Search terms/Subject Headings | Number of results |
|---|---|---|
| 1 | *Child, Preschool/* | 976271 |
| 2 | *(toddler* or preschool* or pre-school* or childcare* or child-care* or "early childhood" or daycare* or day-care* or "age* 2-5").tw.* | 93800 |
| 3 | *1 or 2* | 1014650 |
| 4 | *Guideline/ or Guideline Adherence/* | 51148 |
| 5 | *Organizational Policy/ or Nutrition Policy/ or Health Policy/* | 94850 |
| 6 | *Internet-Based Intervention/ or Early Medical Intervention/* | 4365 |
| 7 | *Health Promotion/* | 79407 |
| 8 | *Health Education/* | 62899 |
| 9 | *Government Regulation/* | 21801 |
| 10 | *Program Evaluation/ or Program Development/* | 87690 |
| 11 | *Diet Therapy/* | 10916 |
| 12 | *Nutrition Therapy/* | 3063 |
| 13 | *Behavior Therapy/* | 29662 |
| 14 | *((health* or diet* or nutrition* or food* or lifestyle*) adj3 (therapy* or guideline* or policy* or policies* or interven* or strateg* or promot* or educat* or program* or counsel* or coach* or regulat* or "behavio?r change")).tw.* | 403188 |
| 15 | *4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14* | 722610 |
| 16 | *Diet, Food, and Nutrition/ or Diet/ or Diet, Healthy/* | 182785 |
| 17 | *eating/ or drinking/* | 68511 |
| 18 | *Energy Intake/* | 43795 |
| 19 | *Feeding Behavior/* | 90358 |
| 20 | *Food Preferences/ or Nutritional Status/* | 66622 |
| 21 | *Recommended Dietary Allowances/* | 2172 |
| 22 | *((diet* adj2 (quality* or intake* or behavior* or behaviour* or pattern*)) or (nutrition* adj2 (behaviour* or behavior* or status* or knowledg* or skill*)) or (food* adj2 (pattern* or habit* or quality* or frequenc* or preferenc* or knowledg* or skill* or belief* or attitude* or provision*)) or ((eating* or feeding*) adj2 (habit* or practic* or pattern*))).tw.* | 151825 |
| 23 | *16 or 17 or 18 or 19 or 20 or 21 or 22* | 455814 |
| 24 | *3 and 15 and 23* | 7227 |
| 25 | *limit 24 to (english language and humans and yr="2000 -Current")* | 5719 |

**Embase via OvidSP**

| Search # | Search terms/Subject Headings | Number of results |
|---|---|---|
| 1 | toddler/ or preschool child/ | 595563 |
| 2 | (toddler* or preschool* or pre-school* or childcare* or child-care* or "early childhood" or daycare* or day-care* or "age* 2-5").tw. | 118088 |
| 3 | 1 or 2 | 660305 |
| 4 | practice guideline/ | 496528 |
| 5 | organizational policy/ or health care policy/ or public policy/ or nutrition policy/ | 220162 |
| 6 | early intervention/ or intervention study/ | 84210 |
| 7 | lifestyle modification/ | 45565 |
| 8 | health promotion/ | 105407 |
| 9 | nutrition education/ or health education/ | 110426 |
| 10 | health program/ or community program/ | 118626 |
| 11 | nutritional counseling/ | 3322 |
| 12 | public health campaign/ | 2797 |
| 13 | government regulation/ | 28285 |
| 14 | diet therapy/ or behavior therapy/ | 102246 |
| 15 | behavior change/ | 44188 |
| 16 | ((health* or diet* or nutrition* or food* or lifestyle*) adj3 (therapy* or guideline* or policy* or policies* or interven* or strateg* or promot* or educat* or program* or counsel* or coach* or regulat* or "behavio?r change")).tw. | 502907 |
| 17 | 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 | 1537752 |
| 18 | diet/ or diet composition/ or unhealthy diet/ or obesogenic diet/ or healthy diet/ | 272435 |
| 19 | child nutrition/ | 17707 |
| 20 | nutritional parameters/ or nutritional health/ or nutritional requirement/ | 29135 |
| 21 | feeding behavior/ | 90466 |
| 22 | dietary intake/ | 89140 |
| 23 | dietary pattern/ | 4973 |
| 24 | eating habit/ | 13958 |
| 25 | nutritional status/ | 75812 |
| 26 | food preference/ | 14705 |
| 27 | caloric intake/ | 70731 |
| 28 | ((diet* adj2 (quality* or intake* or behavior* or behaviour* or pattern*)) or (nutrition* adj2 (behaviour* or behavior* or status* or knowledg* or skill*)) or (food* adj2 (pattern* or habit* or quality* or frequenc* or preferenc* or knowledg* or skill* or belief* or attitude* or provision*)) or ((eating* or feeding*) adj2 (habit* or practic* or pattern*))).tw. | 201120 |
| 29 | 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 | 639703 |
| 30 | 3 and 17 and 29 | 8221 |
| 31 | limit 30 to (human and english language and yr="2000 -Current") | 6714 |

**ERIC via OvidSP**

| Search # | Search terms/Subject Headings | Number of results |
|---|---|---|
| 1 | exp Toddlers/ | 6531 |
| 2 | exp Preschool Children/ | 24478 |
| 3 | (toddler* or preschool* or pre-school* or childcare* or child-care* or "early childhood" or daycare* or day-care* or "age* 2-5").tw. | 95262 |
| 4 | 1 or 2 or 3 | 95262 |
| 5 | exp Guidelines/ or exp Facility Guidelines/ | 26505 |
| 6 | exp Policy Formation/ or exp School Policy/ or exp Public Policy/ or exp State Policy/ | 45318 |
| 7 | exp Early Intervention/ or exp Intervention/ | 62112 |
| 8 | exp Change Strategies/ | 24633 |
| 9 | exp Health Promotion/ | 8642 |
| 10 | exp Health Education/ | 13405 |
| 11 | exp Nutrition Instruction/ | 2574 |
| 12 | exp Family Programs/ or exp Home Programs/ or exp Lunch Programs/ or exp School Community Programs/ or exp Health Programs/ or exp Community Programs/ or exp Breakfast Programs/ | 23182 |
| 13 | exp State Regulation/ or exp Federal Regulation/ | 5610 |
| 14 | exp Behavior Change/ | 12528 |
| 15 | ((health* or diet* or nutrition* or food* or lifestyle*) adj3 (therapy* or guideline* or policy* or policies* or interven* or strateg* or promot* or educat* or program* or counsel* or coach* or regulat* or "behavio?r change")).tw. | 48671 |
| 16 | 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 | 215872 |
| 17 | exp Nutrition/ or exp Eating Habits/ | 9355 |
| 18 | ((diet* adj2 (quality* or intake* or behavior* or behaviour* or pattern*)) or (nutrition* adj2 (behaviour* or behavior* or status* or knowledg* or skill*)) or (food* adj2 (pattern* or habit* or quality* or frequenc* or preferenc* or knowledg* or skill* or belief* or attitude* or provision*)) or ((eating* or feeding*) adj2 (habit* or practic* or pattern*))).tw. | 5551 |
| 19 | 17 or 18 | 10314 |
| 20 | 4 and 16 and 19 | 1005 |
| 21 | limit 20 to (english language and yr="2000 -Current") | 451 |

**Global Health via OvidSP**

| Search # | Search terms/Subject Headings | Number of results |
|---|---|---|
| 1 | preschool children/ | 15921 |
| 2 | (toddler* or preschool* or pre-school* or childcare* or child-care* or "early childhood" or daycare* or day-care* or "age* 2-5").tw. | 39043 |
| 3 | 1 or 2 | 39043 |
| 4 | guidelines/ or dietary guidelines/ | 65346 |
| 5 | nutrition policy/ or food policy/ or health policy/ or government policy/ | 31011 |
| 6 | nutritional intervention/ | 2699 |
| 7 | disease prevention.sh. | 123651 |
| 8 | health promotion/ | 29127 |
| 9 | diet counselling/ | 70 |
| 10 | community education/ or nutrition education/ or health education/ | 30228 |
| 11 | community programmes.sh. | 1841 |
| 12 | therapeutic diets/ | 10315 |
| 13 | behavioural changes.sh. | 5138 |
| 14 | ((health* or diet* or nutrition* or food* or lifestyle*) adj3 (therapy* or guideline* or policy* or policies* or interven* or strateg* or promot* or educat* or program* or counsel* or coach* or regulat* or "behavio?r change")).tw. | 255928 |
| 15 | 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 | 406665 |
| 16 | diet treatment/ or diet counselling/ | 6513 |
| 17 | 15 or 16 | 410217 |
| 18 | (energy intake or nutrient intake).sh. | 30659 |
| 19 | (food intake or intake or diet).sh. | 153309 |
| 20 | eating patterns/ | 9797 |
| 21 | feeding habits/ | 18905 |
| 22 | child nutrition/ or nutrition information/ or nutrition knowledge/ | 10031 |
| 23 | nutritional state.sh. | 34266 |
| 24 | food preferences/ | 13998 |
| 25 | food beliefs/ | 1624 |
| 26 | ((diet* adj2 (quality* or intake* or behavior* or behaviour* or pattern*)) or (nutrition* adj2 (behaviour* or behavior* or status* or knowledg* or skill*)) or (food* adj2 (pattern* or habit* or quality* or frequenc* or preferenc* or knowledg* or skill* or belief* or attitude* or provision*)) or ((eating* or feeding*) adj2 (habit* or practic* or pattern*))).tw. | 185127 |
| 27 | 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 | 301209 |
| 28 | nutrition programmes/ | 7625 |
| 29 | health programmes/ | 26186 |
| 30 | 17 or 28 or 29 | 410217 |
| 31 | 3 and 27 and 30 | 3162 |
| 32 | limit 31 to (english language and yr="2000 -Current") | 2509 |

**The Cochrane Library**

| Search | Search terms/MeSH descriptors | Number of results |
|---|---|---|
| #1 | MeSH descriptor: [Child, Preschool] explode all trees | 31350 |
| #2 | (toddler* or preschool* or pre-school* or childcare* or child-care* or "early childhood" or daycare* or day-care* or "age* 2-5").tw. | 10081 |
| #3 | #1 OR #2 | 41058 |
| #4 | MeSH descriptor: [Guideline] this term only | 0 |
| #5 | MeSH descriptor: [Guideline Adherence] this term only | 1125 |
| #6 | MeSH descriptor: [Organizational Policy] explode all trees | 97 |
| #7 | MeSH descriptor: [Nutrition Policy] explode all trees | 467 |
| #8 | MeSH descriptor: [Health Policy] explode all trees | 698 |
| #9 | MeSH descriptor: [Internet-Based Intervention] this term only | 336 |
| #10 | MeSH descriptor: [Early Medical Intervention] this term only | 426 |
| #11 | MeSH descriptor: [Health Promotion] explode all trees | 7113 |
| #12 | MeSH descriptor: [Health Education] explode all trees | 21271 |
| #13 | MeSH descriptor: [Government Regulation] explode all trees | 26 |
| #14 | MeSH descriptor: [Program Evaluation] explode all trees | 6506 |
| #15 | MeSH descriptor: [Program Development] explode all trees | 744 |
| #16 | MeSH descriptor: [Diet Therapy] explode all trees | 6546 |
| #17 | MeSH descriptor: [Nutrition Therapy] explode all trees | 10290 |
| #18 | MeSH descriptor: [Behavior Therapy] explode all trees | 18612 |
| #19 | ((health* or diet* or nutrition* or food* or lifestyle*) adj3 (therapy* or guideline* or policy* or policies* or interven* or strateg* or promot* or educat* or program* or counsel* or coach* or regulat* or "behavio?r change")).tw. | 10081 |
| #20 | #4 OR #5 OR #6 OR #7 or #8 or #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 | 62688 |
| #21 | MeSH descriptor: [Diet] explode all trees | 20189 |
| #22 | MeSH descriptor: [Diet, Healthy] explode all trees | 628 |
| #23 | MeSH descriptor: [Diet, Food, and Nutrition] explode all trees | 58948 |
| #24 | MeSH descriptor: [Eating] explode all trees | 3909 |
| #25 | MeSH descriptor: [Drinking] explode all trees | 606 |
| #26 | MeSH descriptor: [Energy Intake] explode all trees | 5804 |
| #27 | MeSH descriptor: [Feeding Behavior] explode all trees | 9735 |
| #28 | MeSH descriptor: [Food Preferences] explode all trees | 980 |
| #29 | MeSH descriptor: [Nutritional Status] explode all trees | 2713 |
| #30 | MeSH descriptor: [Recommended Dietary Allowances] explode all trees | 114 |
| #31 | ((diet* adj2 (quality* or intake* or behavior* or behaviour* or pattern*)) or (nutrition* adj2 (behaviour* or behavior* or status* or knowledg* or skill*)) or (food* adj2 (pattern* or habit* or quality* or frequenc* or preferenc* or knowledg* or skill* or belief* or attitude* or provision*)) or ((eating* or feeding*) adj2 (habit* or practic* or pattern*))).tw. | 10082 |
| #32 | #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 | 68526 |
| #33 | #3 AND #20 AND #32 with Publication Year from 2000 to 2022, in Trials | 5085 |
| #34 | #3 AND #20 AND #32 with Cochrane Library publication date Between Jan 2000 and Dec 2022, in Cochrane Reviews, Cochrane Protocols | 4564 |
| #35 | #33 OR #34 | 9649 |

**Supplementary File 3**

**Table S2.3.** DONE framework categories for individual sources of evidence

| Lead author, Year of publication | Title | Socio-ecological level | Stem category | Leaf category | Name of factor/strategy |
|---|---|---|---|---|---|
| Ahern, 2014 | The root of the problem: increasing root vegetable intake in preschool children by repeated exposure and flavour flavour learning | Individual | Biological | Sensory perception | Food liking, learned taste preference |
| Ahern, 2019 | The effects of repeated exposure and variety on vegetable intake in pre-school children | Individual | Biological; Psychological | Sensory perception; Eating regulation | Learned taste preferences, food preferences; Variety seeking, neophobia |
| Alvina, 2004 | Rapid carbohydrate digestion rate produced lesser short-term satiety in obese preschool children | Individual | Biological; Situational | Food-related physiology; Hunger | Appetite; Satiation, hunger |
| Andreyeva, 2018 | Predictors of Nutrition Quality in Early Child Education Settings in Connecticut | Environment; Policy | Meso/Macro; Government | Environment Food Availability And Accessibility; Government Regulations | ECEC food environment; Subsidies for healthy foods |
| Anzman-Frasca, 2012 | Repeated exposure and associative conditioning promote preschool children's liking of vegetables | Individual | Biological | Sensory perception | Food preference, learned taste preference |
| Ashton, 2021 | Dietary outcomes of the "healthy youngsters, healthy dads"™ randomised controlled trial | Individual; Interpersonal | Psychological; Situational; Social | Food knowledge, skills and abilities; Related Health Behaviours; Parental Behaviours | Food familiarity Physical activity level; Parental modeling, parental food habits, parental lifestyle |
| Au, 2016 | Online and In-Person Nutrition Education Improves Breakfast Knowledge, Attitudes, and Behaviors: A Randomized Trial of Participants in the Special Supplemental Nutrition Program for Women, Infants, and Children | Interpersonal | Social | Parental Resources and Risk Factors; Parent Behaviours | Parental nutrition knowledge, parental food product knowledge; Parental food habits; parental food processing (cooking) |

| | | | | | |
|---|---|---|---|---|---|
| Bakirci-Taylor, 2019 | mHealth Improved Fruit and Vegetable Accessibility and Intake in Young Children | Interpersonal; Environment | Social; Micro | Parental Resources and Risk Factors; Home Food Availability and Accessibility | Parental Nutrition Knowledge; Food Accessibility |
| Barkin, 2018 | Effect of a behavioral intervention for underserved preschool-age children on change in body mass index: A randomized clinical trial | Individual; Interpersonal | Psychological; Situational; Social | Food Knowledge, Skills and Abilities<br>Related Health Behaviours; Parental Resources and Risk Factors; Parental Behaviours | Food familiarity; Frequency of television viewing, physical activity level; Parental nutrition knowledge<br>Parental lifestyle |
| Barnes, 2017 | Development of Food Group Books for Three- and Four-Year-Old Children | Individual | Psychological | Food Knowledge, Skills and Abilities | Food familiarity |
| Beck, 2017 | Randomized Controlled Trial of a Clinic-Based Intervention to Promote Healthy Beverage Consumption Among Latino Children | Interpersonal | Social | Parental Resources And Risk Factors; Parental Attitudes and Beliefs | parental nutrition knowledge, parental food product knowledge; Parental trust in food labeling |
| Bell, 2015 | Impact of a nutrition award scheme on the food and nutrient intakes of 2- to 4-year-olds attending long day care | Environment; Policy | Meso/Macro; Government | Environment Food Availability and Accessibility; Campaigns | ECEC food environment; Programs promoting healthy eating |
| Bender, 2013 | A culturally appropriate intervention to improve health behaviors in hispanic mother-child dyads | Individual; Interpersonal | Psychological; Situational; Social; Cultural | Food Knowledge, Skills and Abilities; Related Health Behaviours; Family Food Culture; Parental Resources and Risk Factors; Parental Behaviours; Cultural Cognitions | Food familiarity; Physical activity level (child); Household food processing (cooking); Parental nutrition knowledge; Parental modeling, parental lifestyle; Cultural values |
| Boyer, 2012 | Shape of snack foods does not predict snack intake in a sample of preschoolers: a cross-over study | Individual | Psychological | Sensory Perception | Food liking, food wanting |

| | | | | | |
|---|---|---|---|---|---|
| Braga-Pontes, 2022 | Nutrition education strategies to promote vegetable consumption in preschool children: the Veggies4myHeart project | Individual; | Biological; Psychological | Sensory Perception; Food Knowledge, Skills and Abilities | Food liking, food wanting, learned taste preferences; Food familiarity |
| Brand, 2017 | Comparing strategies to improve the implementation of healthy nutrition in kindergartens: a prospective observational study | Interpersonal; Environment | Social; Meso/Macro | Food Knowledge, Skills and Abilities; Parental Resources And Risk Factors, Parental Behaviours; Environment Food Availability and Accessibility | Food familiarity; parental nutrition knowledge; parental food processing (cooking); ECEC food environment |
| Brown, 2019 | Feasibility of Text Messaging to Promote Child Health in a Rural Community on an American Indian Reservation | Interpersonal | Social | Parental Resources And Risk Factors | parental nutrition knowledge |
| Buscemi, 2019 | Comparative effectiveness trial of an obesity prevention intervention in EFNEP and SNAP-ED: Primary outcomes | Individual; Interpersonal | Psychological; Situational; Social | Food Knowledge, Skills and Abilities; Related health behaviours; Parental Resources And Risk Factors | Food familiarity; Physical activity level; Parental nutrition knowledge |
| Byrd-Bredbenner, 2018 | Promoting healthy home environments and lifestyles in families with preschool children: HomeStyles, a randomized controlled trial | Interpersonal; Environment | Social; Micro | Parental Resources And Risk Factors, Parental Attitudes And Beliefs, Parental Behaviors; Family food Culture, Eating Environment | parental nutrition knowledge; parental weight control goal parental modelling; family food culture; meal environment |
| Cason, 2001 | Evaluation of a preschool nutrition education program based on the theory of multiple intelligences | Individual | Psychological | Food Knowledge, Skills and Abilities | food familiarity |
| Chiasson, 2013 | Changing WIC changes what children eat | Environment; Policy | Micro; Government | Home Food Availability And Accessibility Government Regulations | Food accessibility, food availability Subsidies for healthy foods |
| Choi, 2018 | Fruit and vegetable intakes in relation to behavioral outcomes associated with a nutrition education intervention in preschoolers | Individual | Psychological | Food Knowledge, Skills and Abilities | food familiarity |

| | | | | | |
|---|---|---|---|---|---|
| Cloutier, 2015 | Outcomes from a Pediatric Primary Care Weight Management Program: Steps to Growing Up Healthy | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Attitudes And Beliefs | parental nutrition knowledge<br>parental weight control goal |
| Condrasky, 2006 | Cooking with a Chef: An Innovative Program to Improve Mealtime Practices and Eating Behaviors of Caregivers of Preschool Children | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Attitudes and Beliefs<br>Parental Behaviors | parental nutrition knowledge<br>parental trust in food labeling<br>parental food processing (cooking) |
| Correia, 2014 | Pairing vegetables with a liked food and visually appealing presentation: Promising strategies for increasing vegetable consumption among preschoolers | Individual | Biological | Sensory Perception | Food liking, food wanting, learned taste preferences |
| Corsini, 2013 | Rewards can be used effectively with repeated exposure to increase liking of vegetables in 4-6-year-old children | Individual;<br>Interpersonal | Biological;<br>Social | Sensory Perception<br>Parental Feeding Styles | Food liking, learned taste preferences<br>Parental instrumental feeding |
| Davison, 2013 | A childhood obesity intervention developed by families for families: Results from a pilot study | Interpersonal | Social | Parental Attitudes And Beliefs<br>Parental Resources And Risk Factors<br>Parental Behaviours | Parental weight control concerns, parental perception of child's weight,<br>parental weight control goal<br>Parental nutrition knowledge<br>Parental food habits |
| DeBock, 2012 | Positive impact of a pre-school-based nutritional intervention on children's fruit and vegetable intake: Results of a cluster-randomized trial | Individual;<br>Interpersonal | Psychological;<br>Social | Food Beliefs (psychological)<br>Food Knowledge, Skills and Abilities (psychological)<br>Social Influence (social)<br>Parental Resources And Risk Factors (social)<br>Parental Behaviours (social) | food involvement<br>food familiarity<br>household food processing (cooking)<br>peer modelling<br>parental nutrition knowledge<br>parental modeling,<br>parental food processing (cooking) |

| | | | | | |
|---|---|---|---|---|---|
| DeCoen, 2012 | Effects of a 2-year healthy eating and physical activity intervention for 3-6-year-olds in communities of high and low socio-economic status: the POP (Prevention of Overweight among Pre-school and school children) project | Individual; Interpersonal; Environment | Psychological; Social; Meso/Macro | Food Knowledge, Skills and Abilities<br>Parental Resources And Risk Factors<br>Environment Food Availability and Accessibility | food familiarity<br>parental nutrition knowledge<br>ECEC food environment |
| DeCraemer, 2020 | Combining effect and process evaluation on european preschool children's snacking behavior in a kindergarten-based, family-involved cluster randomized controlled trial: The toybox study | Individual; Interpersonal; Environment | Psychological; Social; Micro; Meso/Macro | Food Knowledge Skills and Abilities<br>Parental Resources And Risk Factors<br>Eating Environment<br>Environment Food Availability and Accessibility | food familiarity<br>parental nutrition knowledge<br>meal environment<br>ECEC food environment |
| deDroog, 2017 | Promoting toddlers vegetable consumption through interactive reading and puppetry | Individual | Psychological | Food Knowledge, Skills and Abilities | food familiarity |
| deSilva-Sanigorski, 2010 | Reducing obesity in early childhood: results from Romp & Chomp, an Australian community-wide intervention program | Individual; Interpersonal; Environment | Situational; Social; Meso/Macro | Related Health Behaviours<br>Social Support<br>Parent Resources and Risk Factors<br>Environment Food Availability And Accessibility<br>Societal Initiatives | Physical activity level, frequency of television viewing<br>Community recommendations<br>Parental nutrition knowledge<br>ECEC food environment<br>Food-related NGO activity |
| DeWild, 2015 | Efficacy of repeated exposure and flavour-flavour learning as mechanisms to increase preschooler's vegetable intake and acceptance | Individual | Biological | Sensory Perception | food preferences, food liking, learned taste preferences |
| Doring, 2016 | Motivational interviewing to prevent childhood obesity: a cluster RCT | Interpersonal | Social | Parental Resources and Risk Factors<br>Parental Behaviours<br>Parental Attitudes and Beliefs | parental nutrition knowledge<br>parental weight control goal<br>parental food habits |

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| DulinKeita, 2014 | Feasibility and acceptability of an early childhood obesity prevention intervention: Results from the healthy homes, healthy families pilot study | Interpersonal; Environment | Social; Micro | Family Food Culture<br>Parental Resources and Risk Factors<br>Parental Behaviours<br>Parental feeding style<br>Eating Environment | Family food culture<br>Parental nutrition knowledge<br>Parental modeling<br>Parental instrumental feeding<br>Meal environment |
| Duncanson, 2013 | Effect of a low-intensity parent-focused nutrition intervention on dietary intake of 2- to 5-year olds | Interpersonal | Social | Parental Resources and Risk Factors | parental nutrition knowledge |
| Dundas, 2004 | Impact of the special supplemental nutrition program for women, infants and children on the healthy eating behaviors of preschool children in Eastern Idaho | Environment; Policy | Micro; Government | Home Food Availability and Accessibility<br>Government regulations | food accessibility; food availability subsidies for healthy foods |
| Endres, 2003 | Soy-enhanced lunch acceptance by preschoolers | Environment | Product | Intrinsic Product Attributes | nutritional composition |
| Esquivel, 2016 | Head Start Wellness Policy Intervention in Hawaii: A Project of the Children's Healthy Living Program | Environment | Micro | Environment Food Availability and Accessibility | ECEC food environment |
| Fildes, 2014 | Parent-administered exposure to increase children's vegetable acceptance: A randomized controlled trial | Individual; Interpersonal | Biological; Social | Sensory Perception<br>Parental Feeding Styles | Food liking<br>Parental instrumental feeding |
| Fisher, 2019 | Title: efficacy of a food parenting intervention for mothers with low income to reduce preschooler's solid fat and added sugar intakes: a randomized controlled trial | Interpersonal | Social | Parental Resources and Risk Factors<br>Parental Behaviours<br>Parental Feeding Styles | parental modeling<br>parental portion size habits, parental food restriction, parental pressure-to-eat, parental instrumental feeding |
| Fitzgibbon, 2005 | Two-year follow-up results for Hip-Hop to Health Jr.: a randomized controlled trial for overweight prevention in preschool minority children | Individual; Interpersonal | Psychological; Situational; Social | Food Knowledge, Skills and Abilities<br>Related Health Behaviours<br>Parental Resources and Risk Factors | food familiarity<br>physical activity level<br>parental nutrition knowledge |
| Fitzgibbon, 2006 | Hip-Hop to Health Jr. for Latino preschool children | Individual; Interpersonal | Psychological; Situational; Social | Food Knowledge, Skills and Abilities<br>Related Health Behaviours<br>Parental Resources and Risk Factors | food familiarity<br>physical activity level<br>parental nutrition knowledge |

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| Fitzgibbon, 2011 | Hip-hop to health Jr. Obesity prevention effectiveness trial: Postintervention results | Individual; Interpersonal | Psychological; Situational; Social | Food Knowledge, Skills and Abilities<br>Related Health Behaviours<br>Parental Resources and Risk Factors | food familiarity<br>physical activity level<br>parental nutrition knowledge |
| Fitzgibbon, 2013 | Family-based hip-hop to health: outcome results | Individual; Interpersonal | Psychological; Situational; Social; Cultural | Food Knowledge, Skills and Abilities<br>Related Health Behaviours<br>Cultural Cognitions<br>Parental Resources and Risk Factors<br>Parental Attitudes and Beliefs | food familiarity<br>physical activity level,<br>cultural norms<br>parental nutrition knowledge<br>parental weight control concerns,<br>parents perception of child's weight |
| French, 2018 | Multicomponent Obesity Prevention Intervention in Low-Income Preschoolers: Primary and Subgroup Analyses of the NET-Works Randomized Clinical Trial, 2012-2017 | Interpersonal; Environment | Social; Micro | Social Support<br>Parental Resources and Risk Factors<br>Parental Behaviours<br>Eating Environment | community recommendations<br>parental nutrition knowledge<br>parental food habits<br>meal environment |
| Gagne, 2013 | Impact of a childcare centre nutrition program: On nutrient intakes in nunavik inuit children | Individual; Environment | Psychological; Meso/Macro | Food Knowledge, Skills and Abilities<br>Environment Food Availability and Accessibility | Food familiarity<br>ECEC food environment |
| Gans, 2022 | A multi-component tailored intervention in family childcare homes improves diet quality and sedentary behavior of preschool children compared to an attention control: results from the Healthy Start-Comienzos Sanos cluster randomized trial | Environment | Meso/Macro | Environment Food Availability And Accessibility | ECEC food environment |
| Gomes, 2018 | Effectiveness of a parental school-based intervention to improve young children's eating patterns: A pilot study | Interpersonal | Social | Parental Resources and Risk Factors<br>Parental Attitudes and Beliefs<br>Parental Feeding Styles | parental nutrition knowledge<br>parental perception of child's weight<br>parental pressure-to-eat |

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| Gomes, 2020 | Predictors of outcomes following a brief portuguese parental nutrition intervention | Interpersonal | Social | Parental Resources and Risk Factors<br>Parental Attitudes and Beliefs<br>Parental Feeding Styles | parental nutrition knowledge<br>parental perception of child's weight<br>parental pressure-to-eat |
| Grummon, 2019 | Effects of a multipronged beverage intervention on young children's beverage intake and weight: a cluster-randomized pilot study | Individual; Interpersonal; Environment | Biological; Psychological; Social; Micro | Food Knowledge, Skills and Abilities<br>Food beliefs<br>Parents Resources and Risk Factors<br>Parental Attitudes and Beliefs<br>Parental Behaviours<br>Eating Environment<br>Environment Food Availability and Accessibility | food familiarity<br>food involvement<br>parental nutrition knowledge; parent food product knowledge<br>parental perception of child's weight; parental trust in food labeling<br>parental food habits<br>meal environment<br>ECEC food environment |
| Guthrie, 2020 | The special supplemental nutrition program for women, infants, and children is associated with several changes in nutrient intakes and food consumption patterns of participating infants and young children, 2008 compared with 2016 | Environment; Policy | Micro; Government | Home Food Availability and Accessibility<br>Government Regulations | food accessibility; food availability<br>subsidies for healthy foods |
| Haire-Joshu, 2008 | High 5 for Kids: The impact of a home visiting program on fruit and vegetable intake of parents and their preschool children | Interpersonal; Environment | Social; Micro | Parental Resources and Risk Factors<br>Parental Behaviours<br>Parental Feeding Styles<br>Home Food Availability and Accessibility | Parental nutrition knowledge<br>Parental modeling<br>Parental pressure-to-eat, parental instrumental feeding<br>Food Availability |

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| Hammersley, 2019 | An internet-based childhood obesity prevention program (TIMe2bhealthy) for parents of preschool-aged children: Randomized controlled trial | Interpersonal | Social | Social Support<br>Parental Resources and Risk Factors<br>Parental Behaviours<br>Parental Feeding Styles | parental recommendations<br>parental nutrition knowledge<br>parental food habits<br>parental food restriction; parental pressure-to-eat |
| Hammersley, 2021 | Translation of Two Healthy Eating and Active Living Support Programs for Parents of 2-6-Year-Old Children: Outcomes of the 'Time for Healthy Habits' Parallel Partially Randomised Preference Trial | Interpersonal | Social | Parental Resources and Risk Factors<br>Parental Behaviours | parental nutrition knowledge<br>parental food habits |
| Heerman, 2019 | Competency-Based Approaches to Community Health: A Randomized Controlled Trial to Reduce Childhood Obesity among Latino Preschool-Aged Children | Individual; Interpersonal | Psychological; Situational; Social | Food Knowledge, Skills and Abilities<br>Related Health Behaviours<br>Parental Resources and Risk Factors<br>Parental Behaviours | food familiarity<br>physical activity level<br>parental nutrition knowledge<br>parental lifestyle; parental food habits |
| Hong, 2018 | A Field Experiment Examining Mindfulness on Eating Enjoyment and Behavior in Children | Individual | Psychological | Eating Regulation | mindful eating |
| Hong, 2018 | Using Family Backpacks as a Tool to Involve Families in Teaching Young Children about Healthy Eating | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Parental Resources and Risk Factors | food familiarity<br>parental nutrition knowledge |
| Horne, 2011 | Increasing pre-school children's consumption of fruit and vegetables. A modelling and rewards intervention | Interpersonal | Social | Social Influence | peer modelling |
| Hughes, 2021 | Twelve-Month Efficacy of an Obesity Prevention Program Targeting Hispanic Families With Preschoolers From Low-Income Backgrounds | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Parental Resources and Risk Factors<br>Parental Feeding Styles | food familiarity<br>parental nutrition knowledge<br>parental portion size habits, parental pressure to eat |
| Hunsaker, 2017 | Effectiveness of a Parent Health Report in Increasing Fruit and Vegetable Consumption Among Preschoolers and Kindergarteners | Interpersonal | Social | Parental Resources and Risk Factors<br>Parental Behaviours | parental nutrition knowledge<br>parental modeling |

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| Iaia, 2017 | An educational intervention to promote healthy lifestyles in preschool children: A cluster-RCT | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Parental Resources and Risk Factors<br>Parental Behaviours | food familiarity<br>parental nutrition knowledge<br>parental food habits |
| Jensen, 2021 | Examining Chile's unique food marketing policy: TV advertising and dietary intake in preschool children, a pre- and post- policy study | Policy | Government | Government Regulations | food advertisement regulations |
| Johnson, 2019 | A longitudinal intervention to improve young children's liking and consumption of new foods: findings from the Colorado LEAP study | Individual | Biological; Psychological | Sensory Perception<br>Food Knowledge, Skills and Abilities<br>Food Beliefs | food liking, learned taste preferences<br>food familiarity<br>food involvement |
| Jones, 2015 | Effectiveness of an intervention to facilitate the implementation of healthy eating and physical activity policies and practices in childcare services: A randomised controlled trial | Environment | Meso/Macro | Environment Food Availability And Accessibility | ECEC food environment |
| Kenney, 2020 | Impact of changes to the Child and Adult Care Food Program on children's dietary intake in family child care homes | Environment; Policy | Meso/Macro; Government | Environment Food Availability And Accessibility<br>Governmental Regulations | ECEC food environment<br>subsidies for healthy foods |
| Kerver, 2022 | Supporting family meal frequency: Screening Phase results from the Simply Dinner Study | Individual; Interpersonal; Environment | Psychological; Social; Micro | Family Food Culture<br>Parental Resources and Risk Factors<br>Parental Behaviours<br>Home Food Availability and Accessibility | household food processing<br>parental nutrition knowledge<br>parental food processing (cooking)<br>food accessibility, food availability |

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| Kim, 2016 | Evaluating an integrated nutrition and parenting education program for preschoolers and their parents | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Parental Resources and Risk Factors<br>Parental Behaviours<br>Parental Feeding Styles | food familiarity<br>food involvement<br>parental nutrition knowledge<br>parental pressure to eat, parental food processing (cooking), parental food habits<br>parental instrumental feeding, parental emotional feeding |
| Kim, 2019 | Effectiveness of teacher-led nutritional lessons in altering dietary habits and nutritional status in preschool children: Adoption of a NASA mission x-based program | Individual | Psychological | Food Knowledge, Skills and Abilities | food familiarity |
| Klohe-Lehman, 2007 | Low-income, overweight and obese mothers as agents of change to improve food choices, fat habits, and physical activity in their 1-to-3-year-old children | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Attitudes And Beliefs<br>Parental Behaviors | parental nutrition knowledge<br>parental weight control goal<br>parental food habits, parental food processing (cooking), parental smart shopping, parental lifestyle |
| Knol, 2016 | Development and Feasibility of a Childhood Obesity Prevention Program for Rural Families: Application of the Social Cognitive Theory | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Eating Regulation<br>Parental Resources And Risk Factors<br>Parental Behaviours<br>Parental Feeding Styles | food familiarity<br>food involvement<br>mindful eating<br>parental nutrition knowledge<br>parental modeling, parental food habits<br>parental portion size habits, food used as an incentive |

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| Knowlden, 2018 | Two-Year Outcomes of the Enabling Mothers to Prevent Pediatric Obesity Through Web-Based Education and Reciprocal Determinism (EMPOWER) Randomized Control Trial | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Behaviors<br>Parental Feeding Styles | parental nutrition knowledge<br>parental modeling,<br>parental food habits<br>parental food restriction, parental instrumental feeding, parental emotional feeding |
| Kong, 2014 | The 18-month impact of special supplemental nutrition program for women, infants, and children food package revisions on diets of recipient families | Environment; Policy | Micro; Government | Home Food Availability And Accessibility<br>Governmental Regulations | food accessibility, food availability<br>subsidies for healthy foods |
| Kong, 2016 | Hip-Hop to Health Jr. Randomized Effectiveness Trial: 1-Year Follow-up Results | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Related Health Behaviours<br>Food Beliefs<br>Parental Resources And Risk Factors | food familiarity<br>physical activity level<br>food involvement<br>parental nutrition knowledge |
| Korenman, 2013 | The Child and Adult Care Food Program and the Nutrition of Preschoolers | Environment; Policy | Meso/Macro; Government | Environment Food Availability and Accessibility<br>Governmental Regulations | ECEC food environment<br>subsidies for healthy foods |
| Korn, 2021 | Role of social ecological model level on young Pacific children's sugar-sweetened beverage and water intakes: Children's Healthy Living intervention | Individual; Interpersonal; Environment; Policy | Psychological; Social; Meso/Macro; Industry | Food Knowledge, Skills and Abilities<br>Social Support<br>Environment Food Availability And Accessibility<br>Industry Influence | food familiarity<br>community recommendations<br>ECEC food environment lobbying |
| Kostecka, 2022 | The Effect of the "Colorful Eating Is Healthy Eating" Long-Term Nutrition Education Program for 3-to 6-Year-Olds on Eating Habits in the Family and Parental Nutrition Knowledge | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Parental Resources And Risk Factors | food familiarity<br>food involvement<br>parental nutrition knowledge |

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| Krieger, 2021 | Countermarketing About Fruit Drinks, Alone or With Water Promotion: a 2019 Randomized Controlled Trial in Latinx Parents | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Attitudes And Beliefs<br>Parental Behaviors | parental nutrition knowledge, parental food market knowledge, parental food product knowledge<br>parental trust in food labeling, parental trust in food producers<br>parental food habits, parental smart shopping |
| Kristiansen, 2019 | Effects of a cluster randomized controlled kindergarten-based intervention trial on vegetable consumption among Norwegian 3-5-year-olds: the BRA-study | Interpersonal; Environment | Social; Micro; Meso/Macro | Social Influence<br>Parental Resources and Risk Factors<br>Parental behaviour<br>Parenting feeding style<br>Home food availability and accessibility<br>Environment food availability and accessibility | peer modelling<br>parental nutrition knowledge<br>parental modeling<br>parental pressure to eat<br>food accessibility, food availability<br>ECEC food environment |
| Kunkel, 2013 | Lessons in a Box Make a Difference for Head Start Youth | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Parental Resources and Risk Factors | food familiarity<br>parental nutrition knowledge |
| Lanigan, 2019 | Child-Centered Nutrition Phrases Plus Repeated Exposure Increase Preschoolers™ Consumption of Healthful Foods, but Not Liking or Willingness to Try | Individual | Biological; Psychological | Sensory Perception<br>Eating Regulation | food liking<br>external eating |
| Leahy, 2008 | Reducing the energy density of multiple meals decreases the energy intake of preschool-age children | Environment | Product | Intrinsic Product Attributes | nutritional composition |
| Leahy, 2008 | Reductions in entree energy density increase children's vegetable intake and reduce energy intake | Environment | Product | Intrinsic product attributes | nutritional composition |

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| Lee, 2017 | Sustainability via Active Garden Education (SAGE): results from two feasibility pilot studies | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Weight Control Cognitions And Behaviors<br>Parental Resources and Risk Factors | food familiarity, food involvement eating in the absence of hunger parental nutrition knowledge |
| Leis, 2020 | Effectiveness of the Healthy Start-Depart Sante approach on physical activity, healthy eating and fundamental movement skills of preschoolers attending childcare centres: a randomized controlled trial | Environment | Meso/Macro | Environment Food Availability And Accessibility | ECEC food environment |
| Ling, 2018 | Using Facebook in a Healthy Lifestyle Intervention: Feasibility and Preliminary Efficacy | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Social Support<br>Parental Resources and Risk Factors<br>Parental Attitudes and Beliefs<br>Parental Behaviours<br>Parental Feeding Styles | food familiarity social support; parental recommendation parental nutritional knowledge parental perception of child's weight, parental trust in food labelling parental food processing (cooking), parental smart shopping parental food restriction, parental pressure-to-eat |

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| Lumeng, 2017 | Improving self-regulation for obesity prevention in head start: A randomized controlled trial | Individual; Interpersonal | Psychological; Social | Self-Regulation<br>Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Parental Resources And Risk Factors<br>Parental Behaviors | self-regulation skills<br>food familiarity<br>food involvement<br>parental nutrition knowledge, parental food market knowledge, parental food product knowledge<br>parental modelling, parental food processing (cooking) |
| Marsh, 2020 | Results of the 3 Pillars Study (3PS), a relationship-based programme targeting parent-child interactions, healthy lifestyle behaviours, and the home environment in parents of preschool-aged children: A pilot randomised controlled trial | Interpersonal | Social | Family Structure<br>Parental Behaviours<br>Parental Feeding Styles | family cohesion<br>parental food habits<br>food used as incentive, parental pressure to eat, parental instrumental feeding |
| Martincrespo-Blanco, 2022 | Effectiveness of an Intervention Programme on Adherence to the Mediterranean Diet in a Preschool Child: A Randomised Controlled Trial | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Parental Resources and Risk Factors | food familiarity<br>food involvement<br>parental nutrition knowledge |
| McGowan, 2013 | Healthy feeding habits: Efficacy results from a cluster-randomized, controlled exploratory trial of a novel, habit-based intervention with parents | Interpersonal | Social | Parental Behaviours | parental food habits |
| McSweeney, 2017 | A feasibility study with process evaluation of a preschool intervention to improve child and family lifestyle behaviours | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Parental Resources And Risk Factors | food familiarity<br>food involvement<br>parental nutrition knowledge |
| Meiqari, 2015 | Exploring the Impact of the New WIC Food Package on Low-Fat Milk Consumption Among WIC Recipients: A Pilot Study | Environment; Policy | Micro; Government | Home Food Availability and Accessibility<br>Government Regulations | food accessibility<br>subsidies for healthy foods |
| Melnick, 2018 | Association of plate design with consumption of fruits and vegetables among preschool children | Individual | Psychological | Eating Regulation | external eating |

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| Melnick, 2020 | Impact of a nutrition education programme on preschool children's willingness to consume fruits and vegetables | Individual | Social | Food Knowledge, Skills and Abilities<br>Food Beliefs | food familiarity<br>food involvement |
| Mirotta, 2018 | Guelph family health study's home-based obesity prevention intervention increases fibre and fruit intake in preschool-aged children | Interpersonal | Social | Parental Behaviour<br>Parental Attitudes and Beliefs | parental lifestyle<br>parental weight control goals |
| Mobley, 2022 | Feasibility, Acceptability, and Preliminary Outcomes of a Father-Focused Childhood Obesity Prevention Program for Low-Income Families with Preschool-Age Children | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Family Food Culture<br>Parental Resources and Risk Factors<br>Parental Attitudes and Beliefs<br>Parental Behaviors<br>Parental Feeding Styles | food familiarity<br>food involvement<br>household food processing (cooking)<br>parental nutrition knowledge<br>parental trust in food labeling<br>parental modeling,<br>parental smart shopping<br>parental food restriction, parental pressure-to-eat |
| Morgan, 2021 | Engaging Fathers to Improve Physical Activity and Nutrition in Themselves and in Their Preschool-Aged Children: The “Healthy Youngsters, Healthy Dads” Feasibility Trial | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Related Health Behaviours<br>Social Support<br>Parental Resources and Risk Factors<br>Parental Attitudes and Beliefs<br>Parental Behaviors<br>Parental Feeding Styles | Food familiarity<br>physical activity level<br>social support<br>parental nutrition knowledge<br>parental weight control concerns,<br>parental weight control goal<br>parental modelling<br>parental food restriction/pressure to eat |
| Morris, 2016 | Feasibility of Conducting a Randomized Trial to Promote Healthy Eating, Active Play and Sustainability Awareness in Early Childhood Curricula | Individual | Psychological | Food Knowledge, Skills and Abilities | food familiarity |

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| Munday, 2017 | Implementing a health and wellbeing programme for children in early childhood: A preliminary study | Individual; Interpersonal; Environment | Psychological; Social; Meso/macro (environment) | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Family Food Culture<br>Environment Food Availability and Accessibility | food familiarity<br>food involvement<br>household food processing (cooking)<br>ECEC food environment |
| Namenek Brouwer, 2013 | Watch me grow: a garden-based pilot intervention to increase vegetable and fruit intake in preschoolers | Individual; Interpersonal; Environment | Psychological; Social; Meso/macro | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Social Influence<br>Environment Food Availability and Accessibility | food familiarity<br>food involvement<br>peer modeling<br>ECEC food environment |
| Natale, 2014 | Effect of a child care center-based obesity prevention program on body mass index and nutrition practices among preschool-aged children | Individual; Interpersonal; Environment | Psychological; Social; Cultural; Meso/Macro | Food Knowledge, Skills and Abilities<br>Parental Resources and Risk Factors<br>Parental Attitudes and Beliefs<br>Parental Behaviours<br>Cultural Cognitions<br>Environment Food Availability And Accessibility | food familiarity<br>parental nutrition knowledge<br>parental perception of child's weight<br>parental modeling<br>cultural beliefs<br>ECEC food environment |
| Natale, 2021 | An Implementation Approach Comparison of a Child Care Center-Based Obesity Prevention Program | Individual; Interpersonal; Environment | Psychological; Social; Meso/Macro | Food Knowledge, Skills and Abilities<br>Social Influence<br>Parental Resources and Risk Factors<br>Parental Behaviours<br>Environment Food Availability And Accessibility | food familiarity<br>peer modeling<br>parental nutrition knowledge<br>parental modeling<br>ECEC food environment |
| Nekitsing, 2019 | Taste Exposure Increases Intake and Nutrition Education Increases Willingness to Try an Unfamiliar Vegetable in Preschool Children: A Cluster Randomized Trial | Individual | Psychological | Sensory Perception<br>Food Knowledge, Skills and Abilities | learned taste preferences<br>food familiarity |

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| Nekitsing, 2019 | Increasing Intake of an Unfamiliar Vegetable in Preschool Children Through Learning Using Storybooks and Sensory Play: A Cluster Randomized Trial | Individual | Psychological | Sensory Perception<br>Food Knowledge, Skills and Abilities | learned taste preferences<br>food familiarity |
| Nezami, 2018 | A mHealth randomized controlled trial to reduce sugar-sweetened beverage intake in preschool-aged children | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Attitudes And Beliefs<br>Parental Behaviors | parental nutrition knowledge<br>parental weight control goal<br>parental food habits |
| Nicklas, 2017 | Motivational theater to increase consumption of vegetable dishes by preschool children | Individual<br>Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Parental Resources and Risk Factors | food familiarity<br>food involvement<br>parental nutrition knowledge |
| Nix, 2021 | Improving toddlers' healthy eating habits and self-regulation: A randomized controlled trial | Individual; Interpersonal | Psychological; Social | Self-Regulation<br>Food Beliefs<br>Family Food Culture<br>Parental Feeding Styles | Self-regulation skills<br>food involvement<br>household food processing (cooking)<br>parental pressure-to-eat |
| Nystrom, 2017 | A 12-month follow-up of a mobile-based (mHealth) obesity prevention intervention in pre-school children: the MINISTOP randomized controlled trial | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Behaviors | parental nutrition knowledge<br>parental food habits |
| O'Connell, 2012 | Repeated exposure in a natural setting: a preschool intervention to increase vegetable consumption | Individual | Psychological | Sensory Perception | learned taste preferences |
| Odoms-Young, 2014 | Evaluating the initial impact of the revised Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) food packages on dietary intake and home food availability in African-American and Hispanic families | Environment; Policy | Micro; Government | Home Food Availability And Accessibility<br>Governmental Regulations | food accessibility, food availability<br>subsidies for healthy foods |
| Pathirana, 2018 | Impact evaluation of "Have Fun - Be Healthy" program: A community based health promotion intervention to prevent childhood obesity | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Parental Behaviors | food familiarity<br>food involvement<br>parental food habits, parental food processing (cooking) |

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| Pearson, 2022 | An mHealth Intervention to Reduce the Packing of Discretionary Foods in Children's Lunch Boxes in Early Childhood Education and Care Services: Cluster Randomized Controlled Trial | Interpersonal | Social | Parental Resources And Risk Factors | parental nutrition knowledge, parental food product knowledge |
| Poeta, 2019 | Waist circumference and healthy lifestyle preferences/Knowledge monitoring in a preschool obesity prevention program | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Eating Regulation<br>Parental Resources And Risk Factors<br>Parental Attitudes And Beliefs<br>Parental Behaviors | food familiarity<br>food involvement<br>neophobia<br>parental nutrition knowledge<br>parental weight control concerns<br>parental food habits, parenting modeling |
| Ray, 2020 | Effects of the Preschool-Based Family-Involving DAGIS Intervention Program on Children's Energy Balance-Related Behaviors and Self-Regulation Skills: A Clustered Randomized Controlled Trial | Individual; Interpersonal; Environment | Psychological; Social; Micro | Self-Regulation<br>Food Knowledge, Skills and Abilities<br>Parental Resources And Risk Factors<br>Parental Behaviors<br>Home Food Availability And Accessibility | Self-regulation skills<br>food familiarity<br>parental nutrition knowledge<br>parental modeling<br>food accessibility, food availability |
| Reale, 2018 | The feasibility and acceptability of two methods of snack portion control in United Kingdom (UK) preschool children: Reduction and replacement | Environment | Product; Micro | Intrinsic Product Attributes<br>Portion Size | nutritional composition<br>portion size |
| Richards, 2009 | An evaluation of an attempt to change the snacking habits of pre-school children using social marketing | Policy | Government | Campaigns | educational campaigns for healthy food |
| Rito, 2018 | Improving breakfast patterns of portuguese children: an evaluation of ready-to-eat cereals according to the European nutrient profile model | Individual | Psychological | Food Knowledge, Skills and Abilities | food familiarity |
| Roberts, 2022 | VeggieSense: A non-taste multisensory exposure technique for increasing vegetable acceptance in young children | Individual | Biological | Sensory Perception | Learned taste preferences/food liking |
| Roe, 2013 | Serving a variety of vegetables and fruit as a snack increased intake in preschool children | Individual | Psychological | Eating Regulation | variety seeking |
| Roe, 2022 | Portion size can be used strategically to increase intake of vegetables and fruits in young children over multiple days: a cluster-randomized crossover trial | Environment | Micro | Portion Size | portion size |

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| Rohde, 2017 | Effects of the Healthy Start randomized intervention on dietary intake among obesity-prone normal-weight children | Individual; Interpersonal | Psychological; Social | Food Beliefs<br>Family Food Culture<br>Parental Resources and Risk Factors | food involvement<br>household food processing (cooking)<br>parental nutrition knowledge |
| Rose, 2014 | Determining the feasibility and acceptability of a nutrition education and cooking program for preschoolers and their families delivered over the dinner hour in a low-income day care setting | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Family Food Culture<br>Parental Resources and Risk Factors<br>Parental Attitudes and Beliefs<br>Parental Behaviours | food familiarity<br>food involvement family food processing (cooking)<br>parental nutrition knowledge<br>parental trust in food labeling<br>parental modeling |
| Salazar, 2014 | Pilot nutrition and physical activity intervention for preschool children attending daycare centres (JUNJI); primary and secondary outcomes | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Parental Resources and Risk Factors | food familiarity<br>parental nutrition knowledge |
| Savage, 2012 | Serving smaller age-appropriate entree portions to children aged 3-5 y increases fruit and vegetable intake and reduces energy density and energy intake at lunch | Environment | Micro | Portion Size | portion size |
| Schuler, 2019 | Building Blocks for Healthy Children: Evaluation of a Child Care Center-Based Obesity Prevention Pilot Among Low-Income Children | Individual; Environment | Psychological; Micro | Food Knowledge, Skills and Abilities<br>Environment Food Availability and Accessibility | food familiarity<br>ECEC food environment |
| Schwartz, 2007 | Office-based motivational interviewing to prevent childhood obesity: A feasibility study | Interpersonal | Social | Parental Resources and Risk Factors<br>Parental Attitudes and Beliefs | parental nutrition knowledge<br>parental weight control goals |
| Seward, 2018 | Improving the implementation of nutrition guidelines in childcare centres improves child dietary intake: Findings of a randomised trial of an implementation intervention | Environment | Meso/Macro | Environment Food Availability and Accessibility | ECEC food environment |
| Sharma, 2019 | Pilot-Testing CATCH Early Childhood: A Preschool-Based Healthy Nutrition and Physical Activity Program | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Parental Resources and Risk Factors | food familiarity<br>food involvement<br>parental nutrition knowledge |

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| Sherwood, 2015 | Pediatric Primary Care-Based Obesity Prevention for Parents of Preschool Children: A Pilot Study | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Attitudes And Beliefs<br>Parental Behaviors | parental nutrition knowledge<br>parental weight control goal<br>parental food habits; parental lifestyle |
| Skouteris, 2016 | A parent-based intervention to promote healthy eating and active behaviours in pre-school children: Evaluation of the MEND 2-4 randomized controlled trial | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Social Influence<br>Parental Resources and Risk Factors | food familiarity<br>peer modelling<br>parental nutrition knowledge |
| Small, 2012 | A parent-directed portion education intervention for young children: Be Beary Healthy | Interpersonal | Social | Parental Resources and Risk Factors<br>Parental Feeding Styles | parental nutrition knowledge<br>parental portion size habits |
| Sobko, 2020 | Does connectedness to nature improve the eating behaviours of pre-schoolers? Emerging evidence from the Play&Grow randomised controlled trial in Hong Kong | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Family Food Culture<br>Parental Resources And Risk Factors<br>Parental Behaviors<br>Parental Feeding Styles | food familiarity<br>food involvement<br>family food culture,<br>family food production<br>parental nutrition knowledge<br>parental food habits,<br>parental modeling<br>parental instrumental feeding, parental emotional feeding,<br>parental pressure-to-eat |
| Spill, 2011 | Hiding vegetables to reduce energy density: An effective strategy to increase children's vegetable intake and reduce energy intake | Individual | Product | Intrinsic Product Attributes | nutritional composition |
| Staiano, 2016 | Influence of Screen-Based Peer Modeling on Preschool Children's Vegetable Consumption and Preferences | Interpersonal | Social | Social Influence | peer modeling |
| Stallings, 2016 | The Georgia WIC Farmers Market Nutrition Program's Influence on Fruit and Vegetable Intake and Nutrition Knowledge and Competencies Among Urban African American Women and Children | Environment; Policy | Micro; Government | Home Food Availability and Accessibility<br>Governmental Regulations | food availability<br>subsidies for health foods |

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| Steenbock, 2019 | Impact of the intervention program "JolinchenKids - fit and healthy in daycare" on energy balance related-behaviors: results of a cluster controlled trial | Individual; Interpersonal; Environment | Psychological; Social; Micro | Mood and Emotions<br>Food Knowledge, Skills and Abilities<br>Parental Resources and Risk Factors<br>Environment Food Availability and Accessibility | wellbeing<br>food familiarity<br>parental nutrition knowledge<br>ECEC food environment |
| Tabak, 2012 | Family Ties to Health Program: A Randomized Intervention to Improve Vegetable Intake in Children | Interpersonal | Social | Parental Resources and Risk Factors<br>Parental Attitudes And Beliefs | parental nutrition knowledge<br>parental weight control goal |
| Tani, 2021 | Association of nursery school-level promotion of vegetable eating with caregiver-reported vegetable consumption behaviours among preschool children: A multilevel analysis of japanese children | Individual; Interpersonal | Psychological; Social | Food Habits<br>Social Support | habitual eating<br>community recommendations, social support |
| Taverno Ross, 2018 | ANDALE Pittsburgh: Results of a promotora-led, home-based intervention to promote a healthy weight in Latino preschool children | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Family Food Culture<br>Social Support<br>Parental Resources and Risk Factors<br>Parental Behaviors | food familiarity<br>food involvement household food processing (cooking)<br>community recommendations<br>parental nutrition knowledge<br>parental food habits, parental lifestyle |
| Tester, 2016 | Revised WIC food package and children's diet quality | Environment; Policy | Micro; Government | Home Food Availability And Accessibility<br>Governmental Regulations | food accessibility, food availability<br>subsidies for healthy foods |
| Tomayko, 2016 | The Healthy Children, Strong Families intervention promotes improvements in nutrition, activity and body weight in American Indian families with young children | Individual; Interpersonal | Psychological; Social; Cultural | Food Knowledge, Skills and Abilities<br>Cultural Cognitions<br>Parental Resources And Risk Factors<br>Parental Behaviours | food familiarity<br>cultural values<br>parental nutrition knowledge<br>parental food habits |

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| Vaughn, 2021 | Evaluating a child care-based social marketing approach for improving children's diet and physical activity: Results from the Healthy Me, Healthy We cluster-randomized controlled trial | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Parental Behaviors | food familiarity<br>parental food habits |
| Vereecken, 2009 | Results from a dietary intervention study in preschools "Beastly Healthy at School" | Individual; Interpersonal; Environment | Psychological; Social; Micro | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Social Influence<br>Parental Resources And Risk Factors<br>Environment Food Availability and Accessibility | food familiarity<br>food involvement<br>peer modeling<br>parental nutrition knowledge<br>ECEC food environment |
| Walton, 2015 | Parents and tots together: pilot randomized controlled trial of a family-based obesity prevention intervention in Canada | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Attitudes And Beliefs<br>Parental Feeding Styles | parental nutrition knowledge<br>parental weight control goal<br>food used as incentive, parental pressure-to-eat, parental food restriction |
| Ward, 2020 | Keys to healthy family child care homes: Results from a cluster randomized trial | Environment | Meso/Macro | Environment Food Availability And Accessibility | ECEC food environment |
| Whiteside-Mansell, 2019 | Evaluation of Together We Inspire Smart Eating: pre-school fruit and vegetable consumption | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Parental Resources And Risk Factors | food familiarity<br>food involvement<br>parental nutrition knowledge |
| Williams, 2014 | Nutrition-education program improves preschoolers' at-home diet: A group randomized trial | Individual; Interpersonal; Environment | Psychological; Social; Meso/Macro | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Eating Regulation<br>Parental Resources and Risk Factors<br>Environment Food Availability And Accessibility | food familiarity<br>food involvement<br>intuitive eating<br>parental nutrition knowledge<br>ECEC food environment |

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|---|---|---|---|---|---|
| Willis, 2014 | Combating child obesity: Impact of HENRY on parenting and family lifestyle | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Behaviors<br>Parental Feeding Styles | parental nutrition knowledge<br>parental modeling, parental food habits<br>parental portion size habits |
| Willis, 2016 | The impact of HENRY on parenting and family lifestyle: A national service evaluation of a preschool obesity prevention programme | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Behaviors<br>Parental Feeding Styles | parental nutrition knowledge<br>parental modeling, parental food habits<br>parental portion size habits |
| Witt, 2012 | Increasing Fruit and Vegetable Consumption among Preschoolers: Evaluation of Color Me Healthy | Individual | Psychological | Food Knowledge, Skills and Abilities<br>Food Beliefs | food familiarity<br>food involvement, food enjoyment |
| Woodward-Lopez, 2018 | Changes in Nutrition Policies and Dietary Intake in Child Care Homes Participating in Healthy Eating and Active Living Initiative | Interpersonal; Environment | Social; Meso/Macro | Parental Resources and Risk Factors<br>Environment Food Availability And Accessibility | parental nutrition knowledge<br>ECEC food environment |
| Wolfenden, 2014 | Randomized controlled trial of a telephone-based intervention for child fruit and vegetable intake: Long-term follow-up | Interpersonal; Environment | Social; Micro | Parental Resources and Risk Factors<br>Parental Behaviours<br>Parental Feeding Styles<br>Home Food Availability and Accessibility | parental nutrition knowledge<br>parental modeling, parental food processing (cooking)<br>parental food restriction, parental pressure to eat<br>food accessibility, food availability |
| Yeom, 2019 | Nutrition education discouraging sugar intake results in higher nutrient density in diets of pre-school children | Individual; Interpersonal | Psychological; Social | Food Knowledge, Skills and Abilities<br>Food Beliefs<br>Parental Resources And Risk Factors | food familiarity<br>food involvement,<br>parental nutrition knowledge |

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|---|---|---|---|---|---|
| Yin, 2012 | Miranos! Look at us, we are healthy! An environmental approach to early childhood obesity prevention | Individual; Interpersonal | Psychological; Situational; Social; Cultural | Food Knowledge, Skills and Abilities<br>Related Health Behaviors<br>Social Influence<br>Cultural Cognition<br>Parental Resources And Risk Factors<br>Parental Attitudes And Beliefs | food familiarity<br>physical activity level<br>peer modeling<br>cultural values<br>parental nutrition knowledge<br>parental weight control concerns |
| Yoong, 2019 | The Impact of a Childcare Food Service Intervention on Child Dietary Intake in Care: An Exploratory Cluster Randomized Controlled Trial | Environment | Meso/Macro | Environment Food Availability and Accessibility | ECEC food environment |
| Yoong, 2020 | Child-level evaluation of a web-based intervention to improve dietary guideline implementation in childcare centers: A cluster-randomized controlled trial | Environment | Meso/Macro | Environment Food and Accessibility | ECEC food environment |
| Zaltz, 2020 | Healthy eating policy improves children's diet quality in early care and education in South Carolina | Environment; Policy | Meso/Macro; Government | Environment Food Availability and Accessibility<br>Governmental Regulations | ECEC food environment<br>Dietary Guidelines |
| Zask, 2012 | Tooty Fruity Vegie: An obesity prevention intervention evaluation in Australian preschools | Interpersonal; Environment | Social; Meso/Macro | Parental Resources and Risk Factors<br>Environment Food Availability And Accessibility | parental nutrition knowledge<br>ECEC food environment |
| Zhang, 2021 | Assessment of Cooking Matters Facebook Platform to Promote Healthy Eating Behaviors among Low-Income Caregivers of Young Children in the United States: A Pilot Study | Interpersonal | Social | Parental Resources And Risk Factors<br>Parental Behaviors | parental nutrition knowledge<br>parental food processing (cooking) |
| Zimmer, 2019 | Changes in nutrient and food group intakes among children and women participating in the Special Supplemental Nutrition Program for Women, Infants, and Children: Findings from the 2005-2008 and 2011-2014 National Health and Nutrition Examination Surveys | Environment; Policy | Micro; Government | Home Food Availability and Accessibility<br>Governmental Regulations | food accessibility, food availability<br>subsidies for healthy foods |

## 2.13 Scoping review update

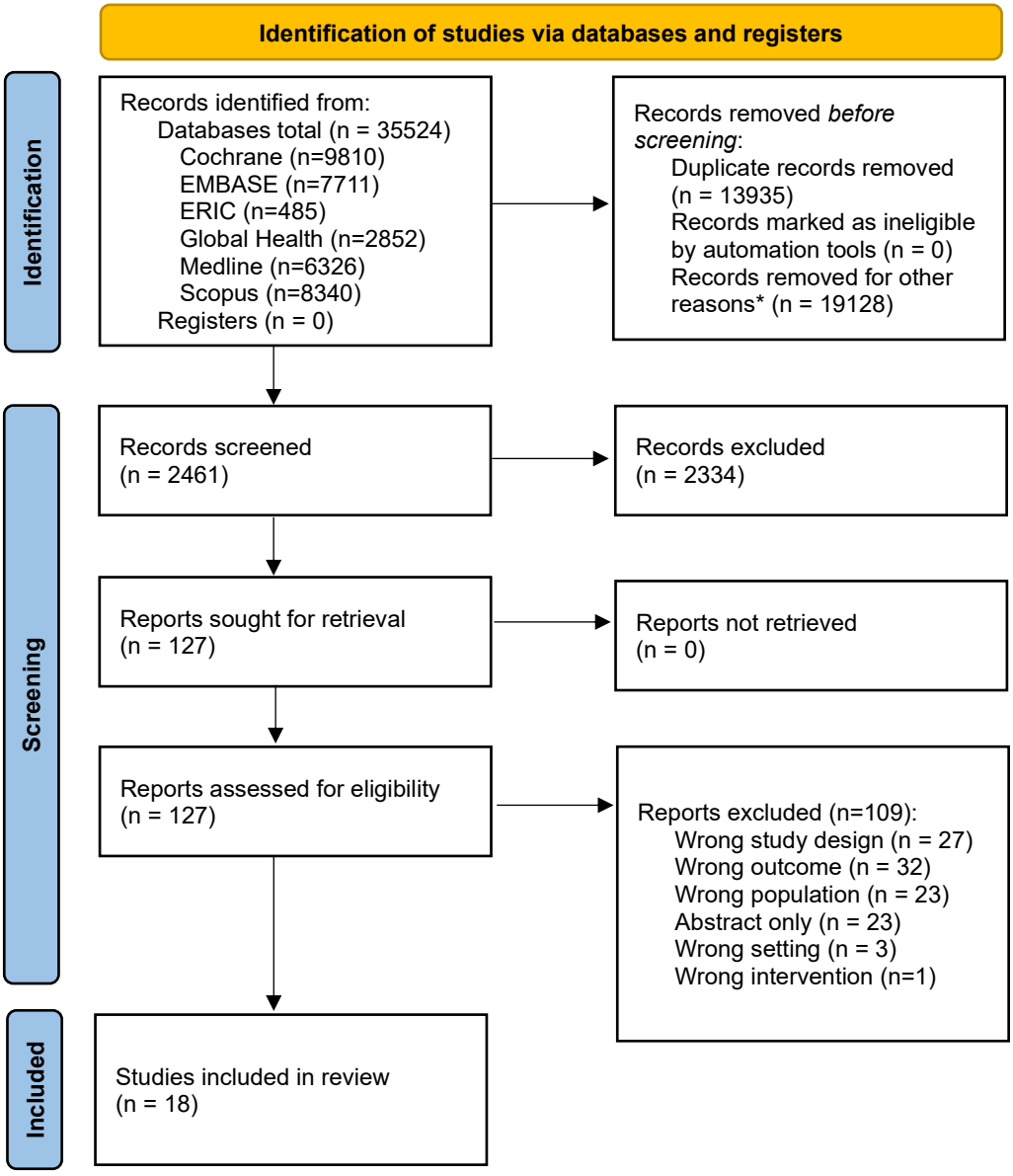
The original scoping review search was performed in May 2022 and run again on 10 January 2024 to capture evidence published between 17 May 2022 and 10 January 2024. The search was conducted using the same six electronic databases: Embase via Ovid (1947 to present), ERIC via Ovid (1966 to present), Global Health via Ovid (1910 to present), MEDLINE via Ovid (1946 to present), Scopus (1996 to present), and The Cochrane Library (Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials [CENTRAL], Cochrane Methodology Register). The same eligibility criteria, search strategy, methods for selection of sources of evidence, and data charting process were applied as described in **Section 2.6**. The updated search strategy was performed and de-duplicated using the methods described by Bramer & Bain (1).

### *2.13.1 Results*

The search yielded 2461 results for screening after de-duplication. Records were screened for title and abstract and 2334 were excluded as they did not meet the inclusion criteria. The remaining 127 records were retrieved for full text review, and 109 records were excluded. The reasons for exclusion are reported in Figure 2.4. The updated search identified 18 new studies that met the eligibility criteria.

Of the 18 studies, ten were conducted in the USA (*n* = 10, 55.6%) and two were conducted in Australia (*n* = 2, 11.1%). The remaining studies were conducted in Chile (*n* = 1, 5.6%), Greece (*n* = 1, 5.6%), Italy (*n* = 1, 5.6%), Sweden (*n* = 1, 5.6%), the Netherlands (*n* = 1, 5.6%), and the United Kingdom (*n* = 1, 5.6%). Majority of studies were conducted in the ECEC setting (*n* = 6, 33.3%) and home setting (*n* = 5, 27.8%), two studies were federal programs (*n* = 2, 11.1%), one study was conducted online (*n* = 1. 5.6%), and three studies were conducted across multiple settings (*n* = 3, 16.7%). Most studies targeted individual (*n* = 8, 44.4%), interpersonal (*n* = 10, 55.6%) and environmental (*n* = 10, 55.6%) level determinants, with fewer targeting policy level determinants (*n* = 3, 16.7%). Most interventions addressed one socioecological level (*n* = 7, 38.9%) or two levels ((*n* = 9, 50.0%), and two studies targeted combined individual, interpersonal and environment level strategies (*n* = 2, 11.1%). There were no studies that included strategies that targeted determinants

across all four levels. The number of studies for each DONE framework category is presented in Table 2.5.




* All records retrieved in the updated search that duplicated those from the original search were removed, remaining records represent newly identified studies.

Figure 2.4 Flow diagram of updated literature search and screening for selection of intervention studies targeting the dietary intake of preschool children aged 2–5 years in high income countries, published in English after January 2000.

*Individual level*

Of the eight studies that targeted individual level determinants, most studies addressed psychological level determinants. Six studies addressed Food Knowledge, Skills and Abilities (2-7) and Food Beliefs (2, 3, 5, 7, 8). Three studies addressed Eating Regulation (4, 6, 9) and three studies addressed emotional Self-Regulation (8)

*Interpersonal level*

Most studies targeting interpersonal level determinants addressed social level determinants. Of the ten studies, eight studies addressed Parental Resources and Risk Factors (4-7, 10-13), four studies addressed Parental Feeding Styles (4, 6, 8, 13), four studies addressed Social Support (5-7, 12), three studies addressed Parental Behaviors (5, 10, 14), three studies addressed Family Food Culture (7, 8, 13), two studies addressed Parental Attitudes and Beliefs (5, 11), and one study addressed family cohesion (11).

*Environmental level*

Of the ten studies targeting the environmental level determinants, six studies addressed Environment Food Availability in the ECEC setting (2, 3, 7, 12, 15, 16). Within the Micro stem category, two studies addressed Home Food Availability and Accessibility (14, 17), one study addressed portion size (9) and one study addressed the home eating environment (6). Two studies changed the nutritional composition of foods offered to children addressing Intrinsic Product Attributes (9, 18).

*Policy level*

All three of the studies targeting policy level determinants were Government Regulation interventions (15, 17, 19). Of these, two studies reported on the CACFP and WIC programs in the United States (15, 17) and one study reported on the Chilean Food Labelling and Advertising Law (19).

Table 2.5 Number of new studies from the updated search conducted in January 2024 and average Determinants of Nutrition and Eating (DONE) framework research priority score.

| Socioecological level | Stem category | Leaf category | Example determinants | Research priority[1] | n (studies) |
|---|---|---|---|---|---|
| Individual | Psychological | Eating regulation | external eating, neophobia, food selectivity, emotional eating, variety seeking, intuitive eating | 1.78 | 3 |
| | | Food Knowledge, Skills and Abilities | food familiarity, food memories | 1.82 | 6 |
| | | Food Beliefs | food involvement, food enjoyment | 2.13 | 5 |
| | | Self-Regulation | self-regulation skills, self-control, emotion suppression, impulsivity, executive functioning | 1.86 | 1 |
| Interpersonal | Social | Family Structure | household size, family cohesion, family composition | 1.43 | 1 |
| | | Family Food Culture | family food culture, household food processing (cooking), family preferences, household food production (growing) | 1.89 | 3 |
| | | Social Support | parental recommendations, social support, community recommendations | 2.12 | 4 |
| | | Parental Resources and Risk Factors | parental nutrition knowledge, parental food market knowledge, parental food product knowledge, parental time constraints, parental depression | 1.99 | 8 |
| | | Parental Attitudes and Beliefs | parental weight control concerns, parental perception of child's weight, parental perceived food safety, parental weight control goal, parental lay food theories, parental trust in food labelling, parental trust in food producers, parental food ethics, parental food risk aversion, parental willingness-to-pay, parental trust in food certification, parental trust in food distribution, parental body dissatisfaction | 1.80 | 2 |
| | | Parental Behaviors | parental modelling, parental food habits parental food processing (cooking), parental lifestyle, parental smart shopping, parental frugality, parental food production (growing) | 2.01 | 3 |

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| | | Parental Feeding Styles | early exposure, parental portion size habits, food used as incentive, parental food restriction, parental pressure-to-eat, parental instrumental feeding, parental emotional feeding | 2.15 | 4 |
| Environmental | Product | Intrinsic Product Attributes | product taste, product texture, product sensory properties, product flavour | 2.13 | 2 |
| | Micro | Portion Size | portion size | 2.41 | 1 |
| | | Home Food Availability and Accessibility | food accessibility, food availability | 2.64 | 2 |
| | | Eating Environment | meal environment | 2.21 | 1 |
| | Meso/Macro | Environment Food Availability and Accessibility | ECEC food environment | N/A | 6 |
| Policy | Government | Governmental Regulations | food advertisement regulations, subsidies for healthy foods, nutrition labeling regulations, market regulations, food label regulations food advertisement bans | 2.03 | 3 |

[1] An average research priority rating (maximum score = 3.00) was calculated for each leaf category by taking the mean of the Overall Priority for Research (OPR) scores assigned to determinants within the DONE framework. Low (mean OPR = 1.00-1.49), Moderate (mean OPR = 1.50-1.99), Substantial (mean OPR = 2.00-2.49) or High (mean OPR = 2.50-3.00).

*Research priorities*

Studies most frequently targeted determinants of "Moderate" research priority, which were addressed 23 times, and determinants of "Substantial" research priority which were addressed 23 times. Home Food Availability and Accessibility was the only determinant with an average OPR rating of "High" and was addressed by two studies. Determinants of "Low" research priority were addressed once.

### *2.13.2 Summary of findings*

Of the 18 new studies identified, most interventions targeted individual ($n$ = 8), interpersonal ($n$ = 10), and environmental ($n$ = 10) level determinants. Majority of the new studies targeted determinants of Moderate and Substantial research priority. Compared with the original search, a higher proportion of recent studies addressed environmental level determinants, suggesting a potential shift in the literature toward improving children's food environments. However, when combined with findings from the original search, individual and interpersonal level determinants remain the most frequently addressed with fewer studies addressing environmental and policy level determinants. Additionally, evidence for policy level action remains limited to studies conducted in the United States and Chile. The findings from the updated search reinforces the conclusions drawn from the original search that highlights research gaps in addressing children's food environments including the ECEC setting and home food availability and accessibility, as well as need for stronger policy level action to address the broader food system. Determinants with a Substantial to High research priority rating remain underexplored, including Intrinsic Product Attributes (Environment), Extrinsic Product Attributes (Environment), Portion Size (Environment), Eating Environment (Environment), Industry Regulations (Policy), Industry Influence (Policy), and Government Campaigns (Policy).

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# Chapter Three: From preschool to policy: a scoping review of recommended interventions for a systems approach to improve dietary intake in early childhood

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## 3.1 Publication details

The chapter is a reformatted version of the manuscript published in *Obesity Reviews* (See Appendix 3.2): Chan J, Conroy P, Phongsavan P, Raubenheimer D, Allman-Farinelli M. From preschool to policy: A scoping review of recommended interventions for a systems approach to improve dietary intake in early childhood. Obesity reviews. 2025:e13897. DOI: 10.1111/obr.13897

The layout, terminology and English language is in accordance with journal requirements. Referencing in this chapter has been changed to be consistent with Vancouver referencing style.

## 3.2 Author contributions

JC, PP, DR and MAF were involved in the conceptualisation and design of the study. JC led the data collection and analysis. JC and PC screened articles and extracted data, with assistance from MAF to resolve uncertainties. JC drafted the manuscript, and all authors were involved in review and editing of the final manuscript.

## 3.3 Introduction to chapter

As outlined in **Chapter Two**, there is a need to map early childhood nutrition interventions and evaluate the impact on dietary outcomes and ensure identified leverage points are effective. This chapter presents the findings from synthesising the outcomes of studies included in the scoping review presented in **Chapter Two** and adds to our understanding of food system determinants by providing an overview of the impact of determinants on children's diets. This chapter includes an updated search of the literature.

## 3.4 Abstract

Early childhood is a key opportunity to establish healthy eating behaviors and prevent future non-communicable disease associated with poor diets. How to effectively intervene in the system of the many determinants influencing children's dietary intake remains unclear. This scoping review aimed to map the determinants of nutrition and eating that have been addressed in early childhood nutrition interventions and identify which of these improve dietary intake. We searched six electronic databases to identify eligible studies published from January 2000 to January 2024. We included studies of any interventions reporting dietary intake among children aged between two and five years. A total of 193 eligible studies were identified and mapped to the Determinants of Nutrition and Eating (DONE) Framework. Parent ($n$ = 97) and child ($n$ = 76) food knowledge and skills were most frequently addressed. Most studies addressing parent (67%) and child (66%) food knowledge and skills reported improvements in dietary intake. Government regulations such as healthy food subsidies, and food advertising and labelling interventions showed promised, with 82% of studies reporting improvements in dietary intake. However, these interventions were predominantly implemented in the United States and Chile. This review provides a comprehensive and systematic map of a range of interventions that positively influence nutritional outcomes in preschool aged children but recommends further policy level action globally.

**Keywords:** children, nutrition, food systems, toddler

### 3.5 Introduction

Sub-optimal diets and high body-mass index (BMI) are among the leading modifiable risk factors for attributable deaths and years of healthy life lost due to premature mortality or disability (1). Despite efforts worldwide, no country has reversed increases in obesity levels and sub-optimal diets continue to threaten public health progress (2). The number of children and adolescents living with obesity has increased globally over the past 40 years and is predicted to continue to rise, reaching 254 million by 2030 (3-5). As rates of childhood obesity continue to rise, the projected worldwide economic burden is estimated to cost the healthcare system $13.62 billion and $49.02 billion in direct and indirect annual costs respectively by 2050 (6).

Improving the quality of children's diets plays a pivotal role in preventing the rising obesity within healthy populations. This not only helps reduce the economic burden, but high-quality diets are also associated with positive outcomes for children, including improved IQ, reduced risk of metabolic syndrome, lower blood pressure, and HbA1c levels, and an overall improvement in mental health-related quality of life (7). Particularly, the first 2000 days of a child's life from conception to 5 years has been proposed to be a critical window of opportunity where children are experiencing rapid growth and developing lifelong skills and habits. (8). However, most children in high-income countries consume insufficient fruit and vegetables and overconsume sugar-sweetened beverages (SSB) (9). In the United States, an analysis of the National Health and Nutrition Examination Survey 2015-2016 estimated that 40% of children aged 2-5 years have poor quality diets, which was defined as less than 40% adherence to the American Heart Association 2020 continuous diet score (10). Similarly, in Australia, children are not meeting national dietary guidelines with less than 5% of children meeting recommendations for vegetables, and 39% of their daily energy intake comes from energy-dense nutrient-poor foods high in added sugar, fat, and salt (11, 12).

It has been proposed that the shift in dietary patterns and increase in obesity rates has been largely driven by the contemporary transformation of the food system (13). The industrialization of food production, technological advances in food processing, and globalization of food distribution has resulted in a food system that prioritizes highly processed, marketed, and affordable foods (14).

Children's diets are influenced by a multitude of interacting determinants with the food system, making it challenging to implement effective interventions (15). During the first 2000 days, children are dependent on parents and caregivers to provide adequate nutrition and make choices about food and eating and thus they play key roles in shaping children's diets and exposure to determinants of obesity (16). Additionally, families are influenced by broader socioecological determinants which encompasses social, cultural, and environmental determinants (8), such as home, school, community, and digital food environments, as well as the policies that impact and regulate them (17, 18) .

Effective long-term interventions are needed to support children to achieve high-quality diets, however, what works in real-world settings remains unclear (19, 20). If population-based strategies are to improve and sustain children's diets, a systems-based approach is necessary (21). Most published reviews have synthesized the evidence specific to a setting or nutrition outcome, however, few reviews have synthesized studies across all socioecological levels to provide a complete overview of the influence of determinants on children's diets. Previous reviews that have taken a systems approach have quantified the number of studies addressing determinants to identify areas most frequently addressed but did not report study outcomes (22, 23). Other reviews have mapped studies according to the socio-ecological model to identify the influence of determinants across individual, interpersonal, environmental, and policy levels (24) or have mapped systematic reviews using the Innocenti Framework to identify which intervention types were effective (25). To inform priority areas for intervention it is important to identify which determinants have been understudied as well as the expected impact of addressing the determinant on children's dietary intake.

This review aims to add to this body of knowledge by scoping the evidence and providing an in-depth map of which determinants improve dietary intake responding to intervention. The review will also determine successful intervention strategies. The review will pinpoint gaps and identify where more evidence is needed in the context of the food system to design effective solutions to improve children's dietary intake. A scoping review was used to explore and map the breadth of evidence to provide a comprehensive overview of the food system that encompasses the wider determinants of nutrition and eating (26).

## 3.6 Methods

This scoping review was conducted following the guidelines and methodology recommended by JBI Manual for Evidence Synthesis and PRISMA extension for Scoping Reviews (Table S3.1) (26, 27).

### *3.6.1 Protocol and registration*

The a-priori protocol for the review was registered on Open Science Framework (registration digital object identifier: https://doi.org/10.17605/OSF.IO/KP49E) on 25 July 2022. Due to the extensive number of studies identified from the search, the protocol was updated on 14 April 2023 to outline changes in reporting outcomes. The methods were previously reported in a separate study mapping the domains of intervention but are reiterated here for completeness and comprehension (22).

### *3.6.2 Eligibility criteria*

Studies that began or targeted children aged between two to five years (up to but not including 6 years) were eligible. Children less than two years were not included due to their different nutritional needs and feeding and eating behaviors. As children's diets are influenced by individual, interpersonal, environmental, and policy factors, interventions targeting key stakeholders at each level including parents, carers and early childhood education and care (ECEC) service staff were also eligible. Studies targeting children with clinical conditions were not eligible as they may require different dietary requirements and feeding practices. We considered any healthy eating interventions designed to improve children's dietary intake. Measures of dietary intake considered for inclusion are outlined in the core outcome set for early childhood obesity prevention intervention studies developed by Brown et al. (28). Multi-component interventions were included if dietary intake outcomes were reported separately. This ensured that the review would be comprehensive and capture all published interventions. Eligible studies were conducted in high-income countries to capture the context of modern food systems, characterized by an abundance of highly-processed food that promotes excessive energy intake (29). Eligible primary research study designs included experimental, quasi-experimental and analytical observational studies such as repeated cross-sectional surveys that reported exposure to intervention and outcome. Studies were eligible if they were published after

January 2000 in the English language to capture interventions relevant to recent public health priorities, policy and practice.

### *3.6.3 Information sources*

The search was conducted across six electronic databases including Embase via Ovid (1947 to present), ERIC via Ovid (1966 to present), Global Health via Ovid (1910 to present), MEDLINE via Ovid (1946 to present), Scopus (1996 to present), and The Cochrane Library (Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials [CENTRAL], Cochrane Methodology Register). Additionally, a search of the reference lists of relevant systematic reviews, meta-analyses, and umbrella reviews was conducted for eligible studies missed by our search. The original search was performed in May 2022 and updated in January 2024 using methods described by Bramer & Bain (30).

### *3.6.4 Search*

The search strategy was designed with an experienced academic librarian. The full electronic search strategy for Medline via Ovid database is provided in Table S3.2.

### *3.6.5 Selection of sources of evidence*

Records identified from the search were de-duplicated using methods described by Bramer et al. managed in Endnote X20 (31). Selection was performed using the pre-specified eligibility criteria in the protocol. To calibrate and refine definitions of eligibility criteria, one author (J.C.) pilot tested the eligibility criteria using a random sample of 25 records. One author (J.C.) screened titles and abstracts of all studies for eligibility using Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia). Full-text records were retrieved for potentially relevant studies and reviewed by two authors (J.C. and P.C.) independently in Covidence. Conflicts were resolved by consensus or decision of a third author (M.A.F.) not involved in the selection process when consensus could not be reached.

### *3.6.6 Data charting process*

The JBI template data charting instrument for scoping reviews and umbrella reviews was adapted for this review (26). One author (J.C.) extracted all data using the pre-specified data charting form and a second author (P.C.) independently extracted 20% of the data for verification in Covidence.

### *3.6.7 Data items*

The data extracted included study characteristics (first author, publication year, country, study design, study aim), inclusion/exclusion criteria, participants (sample size, age, ethnicity, socioeconomic status), intervention characteristics (description, comparator, duration, intensity), and outcomes and measures (data collection methods, outcome measures) and findings relating to children's dietary intake.

### *3.6.8 Synthesis of results*

The determinants addressed by interventions were systematically categorized using the Determinants of Nutrition and Eating (DONE) framework, which was developed by the Determinants of Diet and Physical Activity European research network of 87 members and 129 external experts (32). The framework maps 411 factors driving nutrition and eating behaviour into 56 determinant leaf categories, 11 stem categories, and four socioecological levels (individual, interpersonal, environment, and policy). Determinants related to the childcare food environment were not categorized by the DONE framework, so the existing 'School canteen food environment' determinant was modified to 'Childcare food environment' to capture this.

Studies were categorized by main socio-ecological levels, followed by stem and leaf categories, using extracted data related to intervention characteristics and outcome measures. One author (J.C.) synthesised all studies to the DONE Framework and a second author (P.C.) cross-checked 20% of included studies.

The intervention characteristics, determinants addressed by interventions and outcomes were summarized in narrative form. Findings were organized and presented following the DONE framework stem categories: biological, demographic, psychological, and situational determinants at the individual level; social and cultural determinants at the interpersonal level; product, micro,

meso/macro determinants at the environment level; and industry and government determinants at the policy level. The number of studies that reported statistically significant improvements in outcome measures of diet quality, fruit, vegetable, combined fruit and vegetable, energy-dense nutrient-poor foods, or SSB intake, as outlined in the core outcome set (28), were tabulated against DONE stem categories (Table 3.2) and leaf categories (Table 3.3).

## 3.7 Results

### *3.7.1 Selection of sources of evidence*

In total, 193 studies reported in 242 articles were included in the review following removal of duplicate records, title and abstract, and full-text screening (Figure 3.1). Reasons for exclusion at the full text level are reported in Figure 3.1.

### *3.7.2 Characteristics of sources of evidence*

A summary of the characteristics of the interventions are described in Table 3.1. The majority of studies were conducted in the United States ($n$ = 112). Most studies used an experimental study design ($n$ = 122). Majority were conducted in the ECEC setting ($n$ = 99) including preschools, nurseries, childcare, family childcare homes. Nearly 53% of interventions ($n$ = 102) addressed more than one socio-ecological level of the DONE framework, and of those, 70 studies reported statistically significant improvement in at least one dietary outcome. There were 91 studies that targeted a single, and of those, 69 studies reported at least one improved dietary outcome. The most frequently addressed were individual ($n$ = 102) and interpersonal ($n$ = 116) level determinants. The duration of studies ranged from single day interventions to four years, with the duration of most studies being less than 6 months ($n$ = 113). Intensity of intervention varied greatly between studies where frequency of sessions varied from daily to monthly and length of sessions varied from brief ten-minute interventions to two hours. The sample size of studies ranged between 10 participants (33) to over 500,000 participants per repeated cross-sectional interval (34).

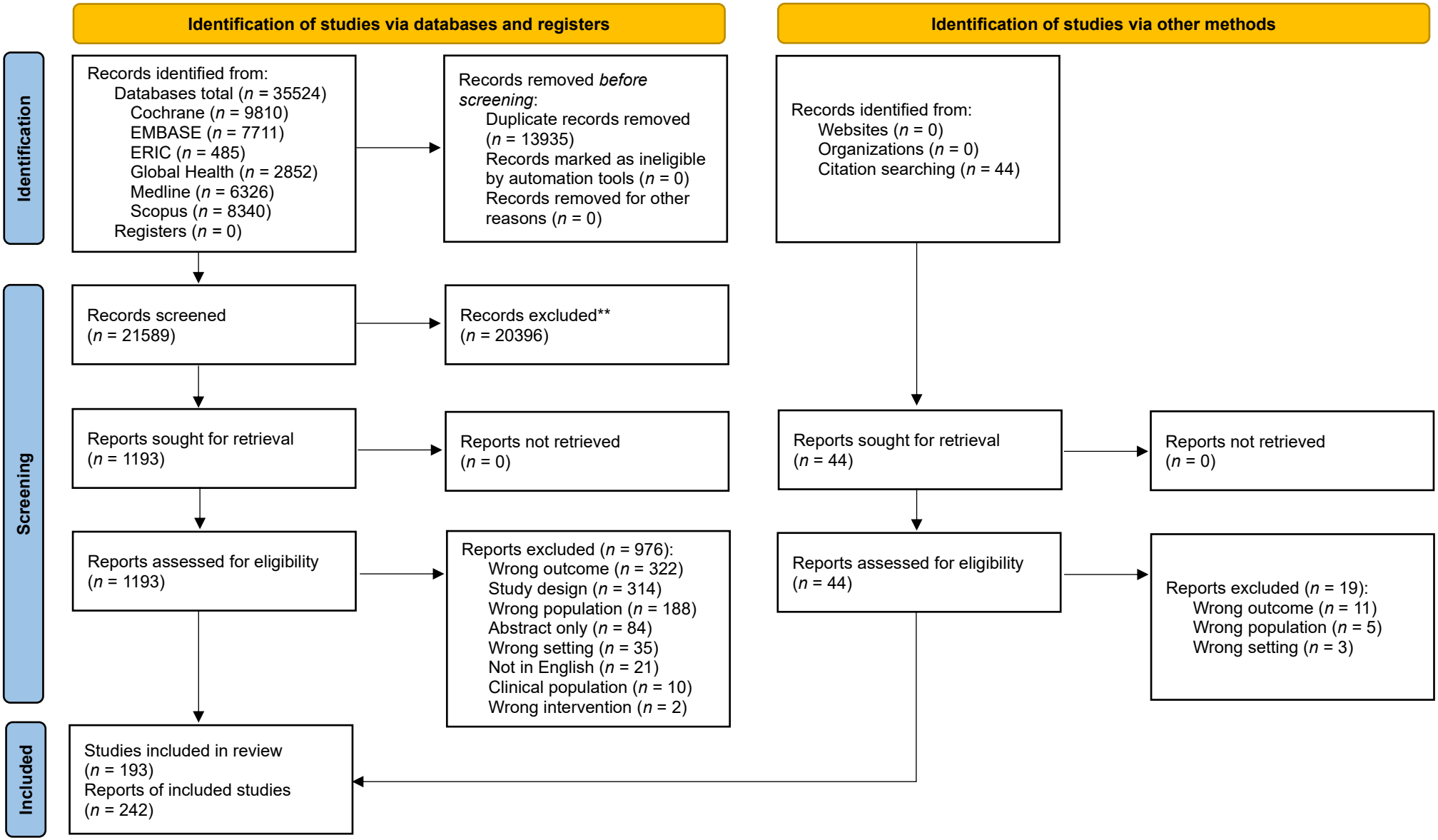


**Figure 3.1.** Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources, as recommended by The PRISMA 2020 statement: an updated guideline for reporting systematic reviews.

**Table 3.1.** Characteristics of included studies ($n$ = 193).

| Study characteristics | Sub-category | Number of results (%) | References |
|---|---|---|---|
| Country | United States | 112 (58%) | (33-143) |
| | Australia | 18 (9%) | (144-161) |
| | United Kingdom | 18 (9%) | (162-179) |
| | Canada | 4 (2%) | (180-183) |
| | Chile | 4 (2%) | (184-187) |
| | Germany | 4 (2%) | (188-191) |
| | Netherlands | 4 (2%) | (192-195) |
| | Portugal | 4 (2%) | (196-199) |
| | Other European | 16 (8%) | (200-215) |
| | Other Asian | 5 (3%) | (216-220) |
| | Other | 4 (2%) | (221-224) |
| Study design | Experimental | 122 (63%) | (36-39, 41, 44, 47, 51, 52, 57-66, 68-73, 76, 83, 85-87, 89, 93, 97-102, 104-107, 110, 112, 113, 115, 116, 119-122, 124, 125, 132, 133, 135-144, 146, 148, 149, 151-154, 156-165, 167-174, 176, 177, 181-184, 189, 190, 192, 193, 195, 196, 200-205, 207, 209-215, 217, 218, 222, 223, 225) |
| | Quasi-experimental | 59 (31%) | (33, 40, 42, 43, 45, 46, 48-50, 53-56, 74, 75, 77-79, 81, 84, 88, 90, 92, 95, 96, 103, 108, 109, 111, 114, 117, 123, 127-130, 134, 145, 147, 150, 155, 166, 178, 179, 185, 187, 188, 191, 194, 197-199, 206, 208, 216, 220, 224, 226) |
| | Analytical observational | 13 (7%) | (34, 35, 67, 82, 94, 118, 131, 142, 175, 180, 186, 219, 221) |
| Setting | Early childhood education and care | 99 (51%) | (35, 36, 40, 43, 46, 48, 51-54, 57, 58, 60-62, 64, 65, 71, 72, 74, 75, 82, 84-88, 95, 97, 98, 100, 102, 104-107, 109, 112, 113, 122-125, 127-129, 132, 134-137, 139-143, 145, 151-153, 157, 159, 160, 162-164, 167, 171, 172, 176, 180, 181, 183, 184, 187-193, 195-198, 201, 205, 206, 209, 212, 213, 215-217, 219, 220, 222, 224, 226) |
| | Home | 44 (23%) | (34, 37, 38, 44, 47, 55, 56, 67, 68, 70, 73, 80, 81, 83, 89, 90, 94, 101, 103, 111, 115, 118, 120, 130, 131, 133, 138, 146, 148-150, 154, 156, 161, 165, 166, 169, 173, 174, 177, 182, 200, 203, 210) |
| | Community | 21 (11%) | (33, 39, 42, 45, 50, 69, 77-79, 96, 99, 114, 117, 144, 147, 175, 214, 218, 221, 223, 227) |
| | Multiple settings | 20 (10%) | (63, 66, 76, 91-93, 110, 116, 119, 121, 168, 170, 185, 186, 194, 199, 204, 207, 208, 211) |
| | Healthcare clinic | 7 (4%) | (41, 49, 108, 158, 178, 179, 202) |
| | Other | 2 (1%) | (59, 155) |
| DONE Framework socioecological level[a] | Individual | 102 (53%) | (33, 36, 39, 40, 42, 43, 46, 48, 51, 52, 60-62, 66, 69-72, 74, 76, 77, 79, 84, 85, 88, 89, 91-93, 95-98, 100-102, 104, 107, 109, 116, 117, 119, 121, 123-125, 128, 132-135, 140-144, 146, 153, 155, 158, 162-166, 170- |

| | | | |
|---|---|---|---|
| | | | 172, 174, 176, 177, 180, 187, 189-193, 195, 196, 199, 201, 203-206, 208, 209, 211-222, 224, 226) |
| | Interpersonal | 116 (60%) | (33, 37-39, 41, 42, 45-47, 49, 50, 54, 55, 59-64, 66, 68-70, 72, 73, 76-80, 83, 84, 88, 89, 91-93, 96-101, 104, 108-111, 113, 115-117, 119-121, 123, 124, 127, 128, 130, 138, 140, 142, 144, 146-150, 155, 156, 158, 160, 161, 165-170, 174, 177-179, 182, 183, 187-191, 194, 197, 198, 200-204, 206-215, 218-223, 227) |
| | Environment | 73 (38%) | (34, 35, 38, 44, 47, 52, 53, 55-58, 63, 65-68, 75, 76, 81, 82, 86, 87, 90, 91, 94, 97, 98, 103-107, 112, 114, 116, 118, 122, 124, 127, 129, 131, 133, 136-139, 142, 145, 147, 151, 152, 154, 157, 159-161, 164, 168, 173, 180, 181, 184, 186, 188, 191, 194, 201, 203, 207, 211, 213, 215, 221) |
| | Policy | 21 (11%) | (34, 35, 53, 56, 67, 75, 81, 82, 90, 94, 103, 114, 118, 129, 131, 145, 175, 185, 186, 221, 227) |
| Duration of intervention | 0 to <3 months | 89 (46%) | (36, 38, 40, 41, 43-46, 59, 66, 70-73, 76-80, 83, 85-88, 92, 96, 100-102, 104-106, 111-113, 117, 124, 125, 130, 132-137, 139, 141, 143, 144, 146, 149, 152, 153, 155, 156, 158, 161, 163-167, 169, 171-174, 176-179, 183, 190, 192, 193, 196-198, 205, 206, 208, 209, 216-218, 220, 223, 224, 226) |
| | 3 to <6 months | 24 (12%) | (48, 52, 55, 60-62, 69, 74, 91, 97, 115, 128, 140, 145, 154, 168, 170, 175, 187, 195, 211, 213, 221, 222) |
| | 6 to < 12 months | 34 (18%) | (33, 37, 42, 49, 54, 56-58, 65, 68, 84, 89, 99, 107, 108, 110, 116, 120-123, 138, 142, 150, 157, 160, 181, 182, 189, 200, 204, 207, 210, 215) |
| | 12 to <24 months | 14 (7%) | (64, 81, 93, 95, 148, 151, 159, 188, 191, 194, 199, 203, 212, 214) |
| | 24 to <36 months | 4 (2%) | (47, 109, 119, 127) |
| | ≥ 36 months | 6 (3%) | (39, 63, 147, 201, 202, 227) |
| | Other[b] | 22 (11%) | (34, 35, 50, 51, 53, 67, 75, 82, 90, 94, 98, 103, 114, 118, 129, 131, 162, 180, 184-186, 219) |
| Sample size | <50 | 39 (20%) | (33, 36, 38, 40, 42, 43, 45, 50, 57, 70, 71, 75, 79, 87, 88, 94, 96, 106, 111-113, 115, 127, 132, 133, 137, 154, 162, 164, 167, 170, 173, 182, 184, 193, 197, 216, 224, 226) |
| | 50 – 150 | 49 (25%) | (41, 51, 55, 56, 59, 69, 73, 78, 80, 85, 86, 89, 91, 92, 97, 99, 102, 103, 105, 108, 110, 114, 117, 119, 120, 135, 136, 139-141, 144, 148, 149, 151, 157, 163, 166, 169, 174, 176-178, 183, 198, 199, 208, 209, 212, 223) |
| | 151 – 500 | 60 (31%) | (44, 46, 47, 49, 52, 54, 58, 60, 61, 65, 66, 72, 74, 76, 77, 81, 84, 100, 101, 107, 116, 122, 125, 128-130, 134, 138, 142, 143, 145, 146, 150, 152, 153, 155, 156, 158, 161, 165, 168, 171, 172, 175, 180, 187-189, 192, 194-196, 203-205, 210, 214, 218, 220, 222) |
| | >500 | 45 (23%) | (34, 35, 37, 39, 48, 53, 62-64, 67, 68, 82, 83, 90, 93, 95, 98, 104, 109, 118, 121, 123, 124, 131, 147, 159, 160, 179, 181, 185, 186, 190, 191, 200-202, 206, 207, 211, 213, 215, 217, 219, 221, 227) |

[a] Studies may address more than one SEM level.

[b] Other includes studies that did not report duration or examined policy implementation.

### *3.7.3 Results of individual sources of evidence*

Child dietary intake outcomes are summarized by DONE framework categories in Tables 3.3-3.4.

### *3.7.4 Synthesis of results*

#### *3.7.4.1 Individual*

*Biological*

There were 18 studies targeting biological determinants and all aimed to influence children's sensory perception and learned taste preferences (Table 3.2). Of these, 11 studies reported improvements in vegetable intake (Table 3.3). One study reported repeated exposure decreased vegetable consumption (102). Of the 11 studies that reported improved outcomes, all interventions involved repeated taste exposure to vegetables offered at meal or snack times by parents in the home setting or ECEC staff in the ECEC setting (74, 85, 134, 146, 165, 166, 176, 177, 193, 195, 226). The number of exposures ranged from daily to twice weekly. Additional strategies such as rewards, dips, encouraging conversations during mealtimes, parent modeling, and multi-sensory exposure may improve vegetable consumption (85, 134, 146, 176, 226).

*Demographic*

No studies addressed demographic determinants (Table 3.2).

*Psychological*

A total of 87 studies addressed psychological determinants and of these, 60 studies reported improvements in one or more measures of dietary intake with the intervention (Table 3.2). Most studies ($n$ = 76) addressed children's food knowledge, skills, and abilities through group nutrition education sessions and of those, a majority of interventions reported improvements in vegetable and combined fruit and vegetable intake and decrease in consumption of energy-dense nutrient-poor foods (Table 3.3). Other dietary intake measures reported included energy intake and fat intake. The three studies that reported intervention effects on energy showed decreased energy intake (39, 187, 222). Two studies reported decreased total fat intake (187) and saturated fat intake (60). Most interventions

addressing children's food beliefs, such as involving children in gardening and food preparation activities, showed improved fruit and vegetable intake, and reduced intake of energy-dense nutrient-poor foods and SSBs (Table 3.3). Nine of 11 interventions addressing children's eating regulation resulted in improvements in all dietary intake outcomes, with most reporting improvements in vegetable intake and combined fruit and vegetable intake and decreased energy-dense nutrient-poor food intake (Table 3.3). Eating regulation interventions included mindful eating activities, offering a variety of vegetables, and portion size plates. Positive outcomes were reported for ECEC based interventions that incorporated nutrition education lessons delivered by ECEC staff into the curriculum (48, 52, 60, 66, 74, 84, 91, 93, 98, 104, 116, 123, 125, 128, 135, 153, 180, 187, 192, 204-206, 209, 211, 216, 217, 219, 222). In addition to nutrition education, some interventions included an interactive component such as food preparation, cooking, and gardening activities (33, 42, 52, 66, 74, 77, 79, 93, 96, 101, 116, 117, 123, 124, 189, 206, 209, 214, 220, 221, 224).

Other strategies used to support and reinforce children's food knowledge, beliefs, and habits included the use of storybooks and/or puppets (70, 77, 100, 104, 123, 128, 135, 158, 171, 192, 224) and rewards such as stickers or praise (85, 100, 104, 133, 166, 174, 224). Many studies also included a parent component in the intervention, however involvement ranged from newsletters and information to targeted family-based workshops (33, 39, 42, 60, 66, 69, 70, 74, 77, 79, 84, 91, 93, 96, 104, 116, 117, 123, 124, 128, 144, 158, 187, 189, 203, 204, 209, 218, 220, 222). Eight studies also included environment and policy changes to support children's eating behaviors (66, 98, 116, 124, 180, 203, 211, 221).

*Situational*

There were 23 studies that included strategies to address related health behaviors including physical activity and screen time (Table 3.2). Of those, 17 studies showed improvement in one or more measures of dietary intake (Table 3.2). Most interventions decreased consumption of energy-dense nutrient-poor foods (Table 3.3). Other dietary intake measures reported included energy intake and fat intake. Two studies reported on energy intake and both decreased energy intake (39, 222). Three studies reported total fat intake but found no significant changes. Two studies reported saturated fat

intake, and one study found intervention reduced intake (60). Of the 17 studies reporting improved dietary intake outcomes, most were family-based, multicomponent interventions that involved both healthy eating and physical activity and conducted in the community setting (39, 42, 69, 79, 96, 117, 144, 147, 158, 214, 228). Other interventions involved incorporating both healthy eating and physical activity components in a classroom-based program delivered by ECEC staff (60, 93, 124, 128, 211, 222).

#### *3.7.4.2 Interpersonal*

*Social*

A total of 117 studies addressed determinants related to social factors. Of these, 81 studies reported improvements in one or more dietary intake outcomes (Table 3.2). There were 13 studies targeting family food culture such as cooking and growing, with most interventions reported improvements in children's vegetable intake (Table 3.3). Most studies addressing social influence such as peer modeling, reported improved fruit and vegetable intake, and reduced intake of energy-dense nutrient-poor foods (Table 3.3). Interventions incorporating components of social or group support for families demonstrated increased vegetable intake and reduced consumption of energy-dense nutrient-poor foods and SSBs in most studies (Table 3.3). Parental resources and risk factors, which focuses on parent nutrition knowledge, was the most frequently addressed determinants ($n$ = 97). Of these studies, most interventions reported reduced energy-dense nutrient-poor food intake but no significant differences for diet quality, fruit, vegetable, and SSB consumption were found (Table 3.3). Most studies addressing parental attitudes and beliefs reported improvements in children's diet quality and decreased consumption of energy-dense nutrient-poor foods (Table 3.3). Of the studies that addressed parental behaviors, most reported non-significant outcomes on children's dietary intake (Table 3.3). Most studies addressing parental feeding styles reported improvements in diet quality, combined fruit and vegetable intake, and reduced energy-dense nutrient-poor food intake (Table 3.3). Of the 80 studies resulting in improved dietary outcomes, majority of interventions were conducted in the home setting, via home visits, telephone, or online (37, 38, 55, 63, 70, 73, 80, 83, 101, 111, 120, 146, 148-150, 161, 165, 166, 169, 174, 177, 182, 200, 203, 210) or in the ECEC setting with a parent

component (54, 60, 64, 66, 84, 91, 93, 95, 98, 100, 104, 113, 116, 123, 124, 128, 160, 167, 187, 189, 194, 197, 198, 204, 206, 208, 209, 211, 219, 220, 222). Most studies were multicomponent and used a range of behavior change techniques including group educational workshops or sessions for parents to provide information and build skills (33, 37, 39, 41, 42, 54, 59, 63, 66, 69, 77-79, 91, 93, 96, 98, 99, 116, 117, 128, 144, 158, 160, 178, 179, 187, 189, 194, 197, 198, 202, 203, 206, 214, 218). Other intervention strategies included individual counseling using motivational interviewing, home visits and feedback reports from health professionals to assist with goal setting, self-monitoring, and habit formation (49, 54, 55, 63, 66, 69, 73, 99, 101, 108, 120, 149, 150, 161, 169, 182, 198, 202, 204, 214). Interventions also included home based tasks or activities, take home written materials, and text message prompts and reminders to cue parental behaviors (38, 39, 54, 55, 60, 64, 66, 70, 84, 91, 93, 99, 100, 104, 111, 117, 120, 123, 124, 128, 144, 147, 160, 161, 177, 197, 198, 204, 208, 209, 211, 218, 220, 222, 227). Some studies created opportunities for parents and children to receive social support peers and other families, through online discussion boards (80, 83, 149, 203). Digital tools including apps, websites, and Facebook were used to deliver nutrition education and support behavior change.

*Cultural*

There were four studies that addressed families' cultural values, beliefs and perceptions about weight. Two of these studies reported improvement in one or more dietary intake outcomes (Table 3.2). Of the two studies that improved outcome measures, both were multi-level, multi-component studies (42, 128). One study, a culturally appropriate center-based program delivered by trained teachers, reported improvements in combined fruit and vegetable consumption (128). One study was a community-based program delivered by trained bilingual community members and reported improvements in SSB, water and milk intake (42).

*3.7.4.3 Environment*

*Product*

All studies addressing product attributes showed improvements in at least one outcome measure of children's dietary intake (Table 3.2). There were eight studies that addressed intrinsic product attributes such as adjusting the nutritional composition of foods offered (Table 3.3). One study addressed extrinsic product attributes through policy to change food labelling. Strategies to replace or substitute meals and snacks with vegetables improved dietary intake (86, 112, 173). Seven studies examined substituting high energy density with low energy density foods or beverages such as soy-enhanced lunches and reduced-fat milk. Of these, four studies reported decreased energy intake (86, 87, 112, 137). One study which aimed to examine the acceptability of soy-enhanced menus and to assess their potential as substitutes for traditional foods reported increased energy intake which was higher than recommendations attributed to the high energy density of soy-enhanced foods (57). One study found that replacing meals with slowly digested carbohydrates lowered energy intake (184). Policy changes to the front-of-package labeling of energy-dense nutrient-poor foods was associated with increased non-nutritive sweetener intake in one study (186). No studies addressing product attributes reported on diet quality, energy dense nutrient poor food intake, or SSB intake. Across the studies that reported one or more improved outcome measures, the majority of interventions were single-level addressing product attributes in the ECEC food environment (57, 86, 87, 112, 137, 184).

*Micro*

A total of 37 studies addressed determinants in the micro food environment including portion size, availability and accessibility of healthy foods and providing a supportive eating environment at home. Of these, 25 studies reported improvement in at least one outcome measure of children's dietary intake (Table 3.2). Of the studies that addressed portion size by adjusting the amount of food served to children at meal or snack times, most interventions improved fruit and vegetable intake (Table 3.3). Three of four studies showed that interventions addressing home food availability and accessibility, such as the provision of food packages, improved diet quality (Table 3.3). Studies addressing the home eating environment, such as changing mealtime structures and creating positive meal environments, reported improvements in diet quality and vegetable intake, however this was inconsistent. Of the 25 studies with one or more improved outcomes, the majority were multi-level

interventions (38, 55, 56, 63, 66, 67, 81, 91, 94, 103, 118, 131, 133, 161, 164, 203, 211). Key strategies of successful interventions included increasing the portion size of fruit and vegetables at meals and snacks (105, 106, 136, 137, 139, 164, 173), and teacher delivered program with home and classroom environment component (66, 91, 211). Change in policy at the federal level to provide food subsidies for healthy foods was associated with improved dietary outcomes (56, 67, 81, 94, 103, 118, 131).

*Meso/macro*

There were 32 studies that addressed the meso/macro environment, and of these, 21 studies reported significant improvements in at least one measure of children's dietary intake (Table 3.2). Studies focusing on the meso/macro environment predominantly targeted food availability and accessibility in ECECs. Four of seven studies reported improvements in children's diet quality (Table 3.3). Interventions that reported improved outcomes used strategies to target the food environment in ECEC settings such as the implementation of staff training (98, 104, 145, 147, 157, 180, 194), health professional feedback and support to revision and implementation of menus and nutrition policy (65, 98, 116, 122, 124, 145, 147, 157, 159, 180), and provision of healthy snacks and water stations (104, 160, 211).

*3.7.4.4 Policy*

*Industry*

One study addressed industry influence (Table 3.2). The intervention provided a template of activities such as lobbying and advocacy for SSB taxation to be implemented by local project teams (221). The intervention was associated with increased water intake but no changes in SSB was found (Table 3.3).

*Government*

Seventeen of 20 studies that included components involving government-level regulations or campaigns to promote healthy eating reported improvement in at least one measure of dietary intake with the intervention (Table 3.2). Most government-level interventions reported improvement in diet

quality (Table 3.3). Most government campaigns showed improvement in fruit intake and reduced consumption of energy-dense nutrient-poor foods (Table 3.3). Of the 17 studies with one or more improved outcomes, most interventions were implemented as a long-term policy change. Implementation of healthy food subsidies for low-income families as part of the Special Supplemental Nutrition program for Women, Infants, and Children (WIC) in the United States was associated with improved dietary intake (56, 67, 81, 94, 103, 118, 131). Healthy food subsidies were also used in the ECEC setting in the United States in conjunction with meal pattern requirements and found improved dietary intake (35, 53, 75, 82). Other successful strategies implemented in the ECEC setting included a state-wide change in dietary guidelines and a program to implement staff training and menu and policy feedback (129, 145). Two studies conducted in Chile found that mandated front of package warning labels, restricting marketing directed at children and banning sale or promotion of energy dense nutrient poor foods in schools and nurseries improved dietary intake (185, 186). However, energy dense nutrient poor food consumption changes were not mediated by changes in advertising exposure which may suggest other aspects of the policy driving changes (185). The policy changes were associated with non-nutritive sweetener intake in children (186). One study reported a social marketing intervention was associated with improved snacking habits (175).

**Table 3.2.** Summary of nutrition interventions studies targeting children aged 2-5 years and reported dietary intake outcomes mapped to the Determinant of Nutrition and Eating Framework stem categories.

| | | Biological | Demographic | Psychological | Situational | Social | Cultural | Product | Micro | Meso/Macro | Industry | Government |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All outcomes [a] | n total [b] | 18 | 0 | 87 | 23 | 117 | 4 | 9 | 37 | 32 | 1 | 20 |
| | Improved (%) [c] | 67% | 0% | 69% | 74% | 69% | 50% | 100% | 68% | 66% | 100% | 85% |
| Diet quality | n total | 0 | 0 | 9 | 5 | 13 | 0 | 0 | 5 | 7 | 0 | 5 |
| | Improved (%) | 0% | 0% | 33% | 40% | 38% | 0% | 0% | 60% | 57% | 0% | 60% |
| Fruit | n total | 0 | 0 | 33 | 11 | 47 | 0 | 1 | 16 | 22 | 0 | 11 |
| | Improved (%) | 0% | 0% | 39% | 18% | 23% | 0% | 0% | 44% | 27% | 0% | 36% |
| Vegetables | n total | 18 | 0 | 53 | 12 | 60 | 0 | 3 | 21 | 24 | 0 | 11 |
| | Improved (%) | 61% | 0% | 55% | 42% | 45% | 0% | 100% | 48% | 38% | 0% | 18% |
| Combined FV | n total | 0 | 0 | 17 | 2 | 29 | 3 | 0 | 11 | 8 | 0 | 4 |
| | Improved (%) | 0% | 0% | 47% | 50% | 34% | 33% | 0% | 36% | 50% | 0% | 25% |
| EDNP | n total | 0 | 0 | 26 | 7 | 40 | 1 | 0 | 8 | 16 | 0 | 7 |
| | Improved (%) | 0% | 0% | 58% | 86% | 55% | 0% | 0% | 13% | 50% | 0% | 57% |
| SSB | n total | 0 | 0 | 27 | 9 | 48 | 2 | 0 | 11 | 6 | 1 | 4 |
| | Improved (%) | 0% | 0% | 30% | 33% | 33% | 50% | 0% | 18% | 33% | 0% | 25% |

Abbreviations: FV, fruit and vegetables; EDNP, energy-dense nutrient-poor; SSB, sugar sweetened beverages

[a] All outcomes includes other reported outcomes such as energy intake not categorized in the table. Diet quality, fruit, vegetables, combined FV, EDNP, and SSB outcomes reported as outlined by COS-EPOCH (28)

[b] n total indicates the number of studies mapped to the Determinants of Nutrition and Eating Framework stem categories. Studies may target multiple stem level categories and may be mapped to more than one category.

[c] Improved outcome (%) heat map describes the percentage of studies with at least one outcome measure with a statistically significant improvement. Grey cells indicate no studies that addressed that determinant category and outcome. Red cells indicate 0-20% studies reporting improved outcomes, orange indicates 21-40% studies reporting improved outcomes, yellow indicates 41-60% studies reporting improved outcomes, light green indicates 61-80% studies reporting improved outcomes, and dark green indicates 81-100% studies reporting improved outcomes.

**Table 3.3.** Summary of nutrition interventions studies targeting children aged 2-5 years and reported dietary intake outcomes mapped to the Determinants of Nutrition and Eating Framework leaf categories.

| | All outcomes[a] | | Diet quality | | Fruit | | Vegetables | | Combined FV | | EDNP | | SSB | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Leaf category** | **n total[b]** | **n (%) improved[c]** | **n total** | **n (%) improved** | **n total** | **n (%) improved** | **n total** | **n (%) improved** | **n total** | **n (%) improved** | **n total** | **n (%) improved** | **n total** | **n (%) improved** |
| **Individual** | | | | | | | | | | | | | | |
| **Biological** | | | | | | | | | | | | | | |
| Sensory Perception | 18 | 11 (61%) | 0 | 0 (0%) | 0 | 0 (0%) | 18 | 11 (61%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) |
| **Psychological** | | | | | | | | | | | | | | |
| Mood And Emotions | 1 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 1 | 0 (0%) | 1 | 0 (0%) | 0 | 0 (0%) |
| Food Knowledge, Skills and Abilities | 76 | 50 (66%) | 2 | 0 (0%) | 20 | 10 (50%) | 32 | 24 (75%) | 10 | 7 (70%) | 17 | 14 (82%) | 17 | 8 (47%) |
| Food Habits | 3 | 3 (100%) | 0 | 0 (0%) | 0 | 0 (0%) | 3 | 3 (100%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) |
| Food Beliefs | 36 | 27 (75%) | 3 | 1 (33%) | 12 | 7 (58%) | 20 | 15 (75%) | 6 | 3 (50%) | 7 | 4 (57%) | 4 | 4 (100%) |
| Eating Regulation | 11 | 9 (82%) | 1 | 0 (0%) | 3 | 1 (33%) | 7 | 4 (57%) | 3 | 2 (67%) | 2 | 2 (100%) | 1 | 0 (0%) |
| Weight Control Cognitions and Behaviors | 1 | 0 (0%) | 0 | 0 (0%) | 1 | 0 (0%) | 1 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) |
| **Situational** | | | | | | | | | | | | | | |
| Related health Behaviors | 23 | 17 (74%) | 5 | 2 (40%) | 12 | 3 (25%) | 13 | 6 (46%) | 2 | 1 (50%) | 7 | 6 (86%) | 10 | 4 (40%) |
| **Interpersonal** | | | | | | | | | | | | | | |
| **Social** | | | | | | | | | | | | | | |
| Family Structure | 2 | 1 (50%) | 0 | 0 (0%) | 2 | 1 (50%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 1 | 1 (100%) |
| Family Food Culture | 13 | 10 (77%) | 3 | 1 (33%) | 5 | 2 (40%) | 7 | 4 (57%) | 3 | 1 (33%) | 2 | 0 (0%) | 8 | 2 (25%) |
| Social Influence | 9 | 6 (67%) | 0 | 0 (0%) | 6 | 4 (67%) | 8 | 5 (63%) | 1 | 1 (100%) | 3 | 2 (67%) | 4 | 0 (0%) |
| Social Support | 14 | 12 (86%) | 1 | 0 (0%) | 6 | 1 (17%) | 9 | 5 (56%) | 3 | 1 (33%) | 3 | 3 (100%) | 8 | 6 (75%) |
| Parental Resources and Risk Factors | 97 | 65 (67%) | 11 | 4 (36%) | 38 | 9 (24%) | 46 | 18 (39%) | 28 | 10 (36%) | 34 | 19 (56%) | 41 | 14 (34%) |
| Parental Attitudes and Beliefs | 25 | 16 (64%) | 3 | 2 (67%) | 6 | 1 (17%) | 8 | 2 (25%) | 7 | 2 (29%) | 7 | 4 (57%) | 15 | 5 (33%) |
| Parental Behaviors | 24 | 14 (58%) | 3 | 0 (0%) | 9 | 3 (33%) | 10 | 5 (50%) | 7 | 2 (29%) | 7 | 3 (43%) | 14 | 5 (36%) |
| Parental Feeding Styles | 25 | 19 (76%) | 4 | 3 (75%) | 8 | 2 (25%) | 12 | 5 (42%) | 7 | 5 (71%) | 8 | 5 (63%) | 5 | 0 (0%) |

| | All outcomes[a] | | Diet quality | | Fruit | | Vegetables | | Combined FV | | EDNP | | SSB | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Leaf category** | **n total[b]** | **n (%) improved[c]** | **n total** | **n (%) improved** | **n total** | **n (%) improved** | **n total** | **n (%) improved** | **n total** | **n (%) improved** | **n total** | **n (%) improved** | **n total** | **n (%) improved** |
| **Cultural** | | | | | | | | | | | | | | |
| Cultural Cognitions | 4 | 2 (50%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 3 | 1 (33%) | 1 | 0 (0%) | 2 | 1 (50%) |
| **Environment** | | | | | | | | | | | | | | |
| **Product** | | | | | | | | | | | | | | |
| Intrinsic Product Attributes | 8 | 8 (100%) | 0 | 0 (0%) | 1 | 0 (0%) | 3 | 3 (100%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) |
| **Micro** | | | | | | | | | | | | | | |
| Portion Size | 7 | 7 (100%) | 0 | 0 (0%) | 4 | 3 (75%) | 6 | 5 (83%) | 1 | 1 (100%) | 0 | 0 (0%) | 0 | 0 (0%) |
| Home Food Availability and Accessibility | 20 | 12 (60%) | 4 | 3 (75%) | 8 | 3 (38%) | 10 | 3 (30%) | 0 | 0 (0%) | 4 | 1 (25%) | 7 | 1 (14%) |
| Eating Environment | 10 | 7 (70%) | 2 | 1 (50%) | 3 | 1 (33%) | 4 | 2 (50%) | 4 | 1 (25%) | 3 | 0 (0%) | 5 | 1 (20%) |
| **Meso/Macro** | | | | | | | | | | | | | | |
| Environment Food Availability and Accessibility | 32 | 23 (64%) | 7 | 4 (57%) | 22 | 6 (27%) | 24 | 9 (38%) | 8 | 4 (50%) | 21 | 9 (43%) | 6 | 3 (50%) |
| Societal Initiatives | 1 | 1 (100%) | 0 | 0 (0%) | 1 | 0 (0%) | 1 | 1 (100%) | 0 | 0 (0%) | 1 | 1 (100%) | 1 | 1 (100%) |
| **Policy** | | | | | | | | | | | | | | |
| **Industry** | | | | | | | | | | | | | | |
| Industry Influence | 1 | 1 (100%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 1 | 0 (0%) |
| **Government** | | | | | | | | | | | | | | |
| Government Regulations | 17 | 14 (82%) | 5 | 3 (60%) | 10 | 4 (40%) | 10 | 3 (30%) | 3 | 1 (33%) | 10 | 3 (30%) | 3 | 0 (0%) |
| Campaigns | 3 | 3 (100%) | 0 | 0 (0%) | 1 | 1 (100%) | 1 | 0 (0%) | 1 | 0 (0%) | 2 | 2 (100%) | 1 | 1 (100%) |

Abbreviations: FV, fruit and vegetables; EDNP, energy-dense nutrient-poor; SSB, sugar sweetened beverages

[a] All outcomes includes other reported outcomes such as energy intake not categorized in the table. Diet quality, fruit, vegetables, combined FV, EDNP, and SSB outcomes reported as outlined by COS-EPOCH (28)

[b] Total (n) indicates the number of studies mapped to the Determinants of Nutrition and Eating Framework leaf categories.

[c] Improved n (%) indicates the number and percentages of studies that reported statistically significant improvements in dietary outcomes.

## 3.8 Discussion

### *3.8.1 Summary of evidence*

This scoping review consolidates the evidence from studies addressing dietary intake in preschool children published in the last 24 years to provide an in-depth overview of interventions in the context of the food system. We identified 193 primary studies, mapped the evidence to the DONE framework, and quantified the number of studies associated with reporting improved outcomes for each determinant. Of the included studies, most interventions addressed social determinants, such as parental nutrition knowledge, skills, habits, and feeding styles, and children's nutrition knowledge and skills at the individual level. These interventions may support improvements in dietary intake in individual children, however, we found gaps in the evidence for other parts of the system which, if considered, may result in more widespread and equitable changes in young children's dietary patterns.

At the individual level, most interventions targeted psychological determinants which included strategies to improve children's nutrition knowledge and skills. Most studies showed targeting children's knowledge using strategies such as nutrition education positively influenced fruit and vegetable intake. However, a systematic review of interventions for increasing fruit and vegetable consumption found that the evidence supporting nutrition education interventions is of low quality and only showed small improvements (229). We found that interventions that addressed other health behaviors such as physical activity and screen time resulted in improved dietary intake, particularly for energy-dense nutrient-poor foods. This is not surprising as higher screen time is associated with increased energy-dense nutrient-poor food intake (230). Additionally, multi-component interventions that target multiple obesogenic behaviors result in better dietary outcomes (231).

Parental nutrition knowledge, skills, and abilities were the most targeted determinant, however, the evidence for improving children's diets was mixed which is consistent with findings of previous systematic reviews. Hodder et al. found overall no effect of parent nutrition education interventions on child fruit and vegetable intake (229). However, another review reported that childcare-based interventions with parental involvement showed promising effects on nutritional-related behavior with interventions that actively involved parents increasing success of behavior change in children (232).

There was also little evidence available for addressing cultural beliefs and behaviors. This suggests that further research is needed to determine the most effective approaches for addressing parent-related determinants and how to best tailor interventions for culturally and linguistically diverse populations. Combining interventions to also target other psychosocial and parenting variables may improve the success of interventions such as parenting and feeding styles (233), parental behaviors and modeling (16), and social influence from siblings (234) and peers even at this young age (235). A systematic review is recommended to identify the most effective strategies to improve the success of parent interventions to improve child dietary intake.

Within children's food environments, home food availability and accessibility have been identified as a critical but understudied determinant (22). Findings from this scoping review suggests that there were some positive effects, predominantly from studies focusing on healthy food subsidy programs in low-income families or increasing portion size to increase fruit and vegetable intake. However, there remains an opportunity to identify effective strategies for decreasing intakes of energy-dense nutrient-poor foods and SSB in the home setting. In a systematic review, Johnson et al. found limited evidence to support the association between availability in the home and reduced intake of studies on child intake of energy-dense nutrient-poor food and beverages (236).

The results appear promising for interventions addressing product attributes. Particularly, there is evidence to support the substitution of meals and snacks served to children with fruit and vegetables to improve consumption and lower energy intake in the home and ECEC settings. However, lower energy intake may not be beneficial for preschool aged children not meeting daily energy requirements. Additionally, energy intake outcomes should be interpreted with caution due to misreporting which may result from subjective parent-reported dietary assessment methods (237). Given the success, effectiveness of scaling up these interventions is recommended particularly in the ECEC setting, where menu policy guidelines can reach many children.

Nutrition interventions in the ECEC setting are well described, however we found that the evidence for improving children's dietary outcomes was mixed. Similarly, a Cochrane review found that interventions in the ECEC setting may improve fruit and vegetable consumption but had little to no

effect on energy-dense nutrient-poor food and SSB, however, the certainty of these findings was limited due to the quality of the evidence (19). Despite 51% of the included studies being conducted in the ECEC setting, there was a lack of policy or sustainability components to embed interventions in the setting. To improve the effectiveness of interventions in the ECEC setting, sustainability needs to be included in the design and adoption phase, and wider policy-level action to ensure consistent implementation across the ECEC system and further implementation support is recommended (238, 239).

The results appear promising for government policy and regulations on children's overall diet quality and energy-dense nutrient-poor food consumption, but the evidence was limited for fruit and vegetable intake. The majority of studies examined the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), and Child and Adult Care Food Programs (CACFP) conducted in the United States which provides healthy food subsidies for low-income households in the home and ECEC setting respectively. Similar to the findings from this scoping review, systematic reviews of the evidence for WIC and CACFP programs indicate that while healthy food subsidies improve purchasing, availability, and accessibility of fruits and vegetables, there is inconsistent evidence that this leads to improved dietary intake in children (240, 241). The federal nutrition assistance programs have great potential to reach and support children, however it has been suggested that further consideration of the broader context of food insecurity, fragmented childcare system in the United States, and adequacy of implementation structure for these programs is needed ensure effective implementation at the population level (242). Leveraging both child nutrition and social protection policy interventions such as the implementation of healthy food programs in childcare in conjunction with subsidies to make childcare more affordable is needed to address the underlying determinants of household food insecurity experienced by low-income families(243). This review found limited studies outside of the United States designed specifically for children from low socioeconomic status communities that leverage both nutrition and social protection policies, suggesting a need for more interventions that target predisposing factors to health and nutrition inequities.

Exposure to food marketing has been shown to have a negative impact on preschool children's food intake, food choice, and food preferences (244, 245). Currently, many countries have adopted industry self-regulation, however mandatory policy approaches to restrict food marketing are more likely to reduce exposure (246). Despite endorsement for stronger legislative action from government to protect children from harmful food marketing (247), implementation across high-income countries is poor. This scoping review found that the only evidence specifically targeting and recognizing the needs of children comes from Chile, as part of a broader evaluation of policies and actions being implemented in Latin America (248). Chile's Food labelling and Advertising Law provides an example of the need for policy coherence and how a comprehensive package of policy options is needed to address multiple determinants and support effective implementation. The initial results are promising and provide evidence of scalability and may act as a "tipping point" for other countries to justify implementation of food marketing policy and legislation around nutrition labeling (249).

The current review examines the evidence for positive dietary change in preschool-aged children against the DONE framework to discover which determinants are understudied and where further evidence is needed. For clarity, the results are presented according to distinct framework categories. However, most studies were complex interventions, targeting multiple determinants across different levels. Potential interactions were not fully captured in this scoping review as most included studies did not report synergistic effects. The evidence suggests that whole-of-system interventions addressing multiple determinants are needed to improve children's diets (250). Recommendations for interventions should take a systems approach to target multiple levels and interactions between determinants (251). Furthermore, most included studies reported fruit and vegetable outcomes. Additional high-quality studies to measure the effect on consumption of energy-dense and nutrient-poor foods and overall diet quality are recommended to provide better picture of the effectiveness of early childhood nutrition interventions.

### *3.8.2 Limitations*

As this was a scoping review, we did not perform a quality assessment and as such included studies may be subject to various biases and the quality of evidence may vary. However, as the purpose of the

review was map the evidence and not to estimate intervention effect size, a scoping review was used which allowed for the inclusion of these studies to provide complete and comprehensive overview (252). Subsequent systematic reviews and meta-analysis with risk of bias and sub-group analysis assessments can be undertaken as recommended based on the results of this scoping review to determine effectiveness of interventions targeting specific determinants.

Given the large body of literature on early childhood nutrition, it is important to consolidate and map the evidence to identify gaps and provide guidance for further research. A significant strength of this scoping review is the level of detail included by using the DONE framework to systematically map early childhood nutrition interventions. We were able to map the evidence to the framework of 411 determinants and then categorise these into leaf and stem-categories to synthesise and provide an overview of the evidence. Gaps in the evidence-base and areas where more primary studies are warranted to enable systematic reviews and causality to be determined were identified. The framework provides a novel and systematic way to categorise a broad range of determinants relevant to children, however, iterative updates are needed to accurately reflect current determinants and their interactions as they change, and new priorities arise.

## 3.9 Conclusion

This review provides a systematic map of early childhood nutrition interventions. Interventions targeting children's individual psychological and biological determinants are well studied and can be effective at improving children's dietary intake. Social determinants, particularly parental nutrition knowledge, skills, attitudes and beliefs were commonly addressed, however there is limited evidence that targeting this leads to improved dietary outcomes in children. There is evidence to suggest interventions addressing environment and policy-level determinants may improve the success of interventions. While most studies were conducted in ECEC settings, there was a lack of studies investigating policy to support cohesive implementation and sustainment of interventions. Manipulating the nutritional composition of meals and snacks provided to children at home and in the

ECEC setting is a promising but under-explored gap that should be leveraged. Interventions addressing policy-level determinants including healthy food subsidy programs and food marketing and labelling laws are recommended as implementation is currently limited to the Unites States and Chile.

## 3.10 Conclusion to chapter

Building on the findings from the scoping review presented in Chapter Two which identified underexplored determinants, Chapter Three identified which determinants, when targeted by interventions, are more likely to lead to improvements in children's dietary intake. These findings help identify key leverage points and understand which determinants are most influential in improving children's dietary intake when targeted by interventions. The findings from this review provide recommendations for policy and practice in the ECEC setting and beyond to facilitate successful and sustained improvements in children's diets. This chapter suggests that while interventions most frequently targeted children's and parents' nutrition knowledge and there may be some improvements in dietary outcomes, evidence from systematic reviews indicate only modest improvements in outcomes, with overall low quality of evidence. Inadequate policy intervention to ensure healthy and supportive food environments can attenuate impact as unhealthy food environments can undermine parent choices. Findings from Chapter Two identified environment and policy level determinants remain underexplored and emphasised the need for greater attention to children's immediate food environments including ECEC and home settings, as well as the broader influences including local food retail, marketing to children, and food-related policies.

At the environment and policy level, findings from Chapter Three indicate that interventions addressing intrinsic product attributes such as the nutritional composition of food, industry and government determinants were the most promising. Although interventions targeting industry determinants showed promise, only one intervention was identified, and further evidence is needed to determine which policy components impact children's dietary intake. Interventions addressing

determinants related to government regulations targeting the home and ECEC setting appear promising. These interventions were mostly healthy food subsidy programs which can improve food purchasing. However, in the home setting, home food availability and accessibility may not always lead to improved dietary intake as it is dependent on factors such as parental feeding practicing and broader socioeconomic constraints. Notably, interventions addressing the nutritional composition of meals and snacks provided in the ECEC setting, through strategies such as improving menu compliance, was identified as a promising but under-explored gap. Furthermore, ECEC-based interventions with a parent component may be more effective than parent intervention alone. ECEC settings operate under regulatory frameworks that make them well-suited for implementing and scaling nutrition interventions through government policy and programs. These findings suggest that the ECEC setting is a key leverage point, and this chapter recommends implementing these interventions at the population level through government regulation and programs.

Although interventions in the ECEC setting have great potential to reach children and support healthy diets, the evidence remains inconsistent. There remains an opportunity to identify solutions to address environment and policy level government determinants in the ECEC setting. Chapter One highlights that effective and sustainable solutions require well-designed policies and programs that account for contextual factors influencing implementation. As policy and program end-users, directors, educators, and cooks are well-positioned to provide meaningful insights about the operational environment, resource constraints, and cultural factors within ECEC settings that policy makers may overlook.

**Chapter Four** and **Chapter Five** will thus explore how to address environment and policy determinants influencing food and nutrition in the ECEC setting. This will inform a systems-based approach to facilitate the successful and sustained implementation of ECEC-based healthy eating interventions. In the next chapter, qualitative methods will be used to explore the perspectives of ECEC directors to understand how environment and broader policy level contextual factors in the ECEC setting influence implementation of healthy eating policies and practices.

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### 3.12 Supplementary material

**Table S3.1.** Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a scoping review. | Title Page, Page 1 |
| **ABSTRACT** | | | |
| Structured summary | 2 | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | Abstract, Page 1 |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | Introduction, Pages 2-3 |
| Objectives | 4 | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | Introduction, Page 3 |
| **METHODS** | | | |
| Protocol and registration | 5 | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | Methods, Page 4 |
| Eligibility criteria | 6 | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | Methods, Page 4 |
| Information sources* | 7 | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | Methods, Page 5 |
| Search | 8 | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | Supplementary material, Table S2 |
| Selection of sources of evidence† | 9 | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. | Methods, Page 5 |
| Data charting process‡ | 10 | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | Methods, Page 6 |
| Data items | 11 | List and define all variables for which data were sought and any assumptions and simplifications made. | Methods, Page 6 |

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| Critical appraisal of individual sources of evidence§ | 12 | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | N/A, not conducted |
| Synthesis of results | 13 | Describe the methods of handling and summarizing the data that were charted. | Methods, Page 6 |
| **RESULTS** | | | |
| Selection of sources of evidence | 14 | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | Results, Figure 1 |
| Characteristics of sources of evidence | 15 | For each source of evidence, present characteristics for which data were charted and provide the citations. | Results, Table 1 |
| Critical appraisal within sources of evidence | 16 | If done, present data on critical appraisal of included sources of evidence (see item 12). | N/A, not conducted |
| Results of individual sources of evidence | 17 | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | Results, Table 3-4 |
| Synthesis of results | 18 | Summarize and/or present the charting results as they relate to the review questions and objectives. | Results, Pages 10-16 |
| **DISCUSSION** | | | |
| Summary of evidence | 19 | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | Discussion, Page 20-23 |
| Limitations | 20 | Discuss the limitations of the scoping review process. | Discussion, Page 23-24 |
| Conclusions | 21 | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | Discussion, Page 24 |
| **FUNDING** | | | |
| Funding | 22 | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | Title Page |

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.
* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).
‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

*From:* Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.

**Table S3.2.** The full electronic search strategy performed on 10 January 2024 using Medline via Ovid (1946 – 10 January 2024)

| | | |
|---|---|---|
| **1** | *Child, Preschool/* | 995118 |
| **2** | *(toddler* or preschool* or pre-school* or childcare* or child-care* or "early childhood" or daycare* or day-care* or "age* 2-5").tw.* | 104007 |
| **3** | *1 or 2* | 1038383 |
| **4** | *Guideline/ or Guideline Adherence/* | 51531 |
| **5** | *Nutrition Policy/ or Organizational Policy/ or Health Policy/* | 96990 |
| **6** | *Early Medical Intervention/* | 3449 |
| **7** | *Internet-Based Intervention/* | 1185 |
| **8** | *Health Promotion/* | 82144 |
| **9** | *Health Education/* | 64011 |
| **10** | *Government Regulation/* | 21892 |
| **11** | *Program Evaluation/ or Program Development/* | 88614 |
| **12** | *Diet Therapy/* | 10919 |
| **13** | *Nutrition Therapy/* | 3213 |
| **14** | *Behavior Therapy/* | 30642 |
| **15** | *((health* or diet* or nutrition* or food* or lifestyle*) adj3 (therapy* or guideline* or policy* or policies* or interven* or strateg* or promot* or educat* or program* or counsel* or coach* or regulat* or "behavio?r change")).tw.* | 467362 |
| **16** | *4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15* | 790343 |
| **17** | *Diet, Food, and Nutrition/ or Diet, Healthy/ or Diet/* | 195275 |
| **18** | *eating/ or drinking/* | 71183 |
| **19** | *Energy Intake/* | 45242 |
| **20** | *Feeding Behavior/* | 93469 |
| **21** | *Food Preferences/ or Nutritional Status/* | 71195 |
| **22** | *Recommended Dietary Allowances/* | 2202 |
| **23** | *((diet* adj2 (quality* or intake* or behavior* or behaviour* or pattern*)) or (nutrition* adj2 (behaviour* or behavior* or status* or knowledg* or skill*)) or (food* adj2 (pattern* or habit* or quality* or frequenc* or preferenc* or knowledg* or skill* or belief* or attitude* or provision*)) or ((eating* or feeding*) adj2 (habit* or practic* or pattern*))).tw.* | 172041 |
| **24** | *17 or 18 or 19 or 20 or 21 or 22 or 23* | 489321 |
| **25** | *3 and 16 and 24* | 7698 |
| **26** | *limit 25 to (english language and yr="2000 -Current")* | 6326 |

# Chapter Four: Contextual influences on the success of healthy eating policies and practices in Australian early childhood education centres: A qualitative study with directors

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## 4.1 Publication details

The chapter presents the manuscript published in *Nutrients* (see Appendix 3.3): **Chan J**, Hyde-Page A, Phongsavan P, Raubenheimer D, Allman-Farinelli M. Contextual influences on the success of healthy eating policies and practices in Australian early childhood education centres: A qualitative study with directors. Nutrients. 2025;17(16):2661.

The layout, terminology and English language is in accordance with journal requirements. Referencing in this chapter has been changed to be consistent with Vancouver referencing style.

## 4.2 Author contributions

JC, PP, DR and MAF were involved in the conceptualisation and design of the study. JC and AHP were involved in participant recruitment. JC led the data collection and analysis. MAF was the second data coder and reviewed a sub-set of the data. JC drafted the manuscript, and all authors were involved in review and editing of the final manuscript.

### 4.3 Introduction to chapter

As outlined in **Chapter Two**, early childhood nutrition interventions addressing environment and policy level determinants were underexplored and highlights the need to strengthen action to address children's food environments. **Chapter Three** identified that interventions addressing environment and policy level determinants influencing the ECEC setting can be effective in improving children's dietary outcomes. Potential leverage points include interventions to address the ECEC food environment, the nutritional composition of food provided, and government regulations to support healthy eating in the ECEC setting. However, further research to understand the environment and policy level determinants is recommended to support implementation for sustained population-level impact of healthy eating interventions in the ECEC setting.

Examining the contextual factors surrounding implementation of healthy eating interventions can provide a better understanding of the environment and policy level determinants that shape food and nutrition in the ECEC setting. These determinants include support, leadership and resources available at the organisational level, as well as broader factors such as the regulatory environment, funding models, and availability of external support services across the sector. The Consolidated Framework for Implementation Research (CFIR) provides a systematic approach to assessing these determinants and identifying the barriers and enablers to implementation. A strength of applying the CFIR framework is its "outer setting" domain, which capture the broader environmental and policy contexts that shape service-level decisions and influence the delivery of healthy eating policies and practices.

There is a substantial body of evidence examining the barriers and enablers to implementing healthy eating policies and practices in the Australian ECEC setting. A qualitative study conducted with directors in Queensland examined the barriers and enablers to a healthy food environment and identified organisational barriers such as centre policies not tailored to services and competing demands on time for staff (1). In Victoria, an online survey of barriers and enablers to implementation of menu planning guidelines assessed organisational level factors such as knowledge of staff responsible for menu planning, confidence in implementation and recognition and award processes within centres (2). In South Australia, a qualitative study conducted with cooks found that the absence

of training and support at the systems-level was a barrier to food service provision (3). However, it is important to understand the unique contextual factors that shapes the implementation of healthy eating policies and practices across each jurisdiction given that health operates at a state-level, nutrition support in the ECEC setting is regulated by each state and territory, and the level of nutrition support varies across each jurisdiction. Understanding the contextual factors in ECECs in NSW provides a unique perspective as it is one of three jurisdictions with a state-funded healthy eating program. Previous studies have explored the factors influencing implementation of healthy eating policies and practices in NSW but notably these studies use a deductive quantitative approach (4, 5). While quantitative methods can determine the association between predefined factors, they may not capture nuanced, context-specific factors that influence implementation. Notably, most studies examining barriers and facilitators influencing the implementation of healthy eating policies and practices in the Australian ECEC setting focus on describing organisational level factors and overlook the influence of broader contextual influences. Further research into system-level factors on policy implementation in NSW could also inform support strategies in the ECEC setting across other jurisdictions who do not currently have state-funded healthy eating support. The qualitative studies presented in **Chapter Four** and **Chapter Five** address the research gap by examining both inner setting organisational factors and system-level outer setting factors by using qualitative methods guided by CFIR.

### *4.3.1 Qualitative methods*

In this section, an overview is presented of the methods used in the qualitative studies presented in **Chapter Four** and **Chapter Five**. Within qualitative research, face-to-face interviews have traditionally been considered the "gold standard" because they allow the interviewer to build rapport, capture non-verbal cues, and respond directly and spontaneously to participants' reactions (6). Physical presence can create a good conversational flow, interview ambiance, and provide additional information about the environmental context such as the physical environment in which the participants work (7). However, face-to-face interviews are more resource-intensive, requiring more time and travel for the interviewer. Video conferencing methods such as Zoom have become increasingly common, especially following the COVID-19 pandemic (8). Video conferencing can be

more accessible and convenient, enabling participation from geographically dispersed samples or hard-to-reach groups and allow for flexible scheduling (8, 9). Video conferencing can also reduce the time and travel burden for interviewers. However, video conferencing may limit the ability to observe subtle non-verbal cues and the environmental context, which may reduce rapport with participants. Potential technological issues, home or work distractions, and exclusion of individuals without technology access or skills can affect interview data (6, 7). There are discrepancies in findings in the literature about richness of data when comparing face-to-face and video conferencing. In a comparative study of face-to-face and video conferencing interviews, it was found that both interviews modes produced a similar number of words and codes, but there were a higher number of statements produced for face-to-face interviews, suggesting a greater depth of discussion (10). In contrast, studies have also demonstrated that video conferencing can also build rapport and generate richness of data similar to face-to-face interviews (8).

Both face-to-face and video conferencing modes have unique advantages and disadvantages that can affect the quality and richness of data collected. (8, 10). Johannessen et al. argue that different modes have different strengths and weaknesses across specific participants and circumstances and the quality of interview depends on contextual factors (7). The choice of interview mode should be guided by the research aims, analytical strategies and population being studied. For example, face-to-face interviews can generate richer data in individual interviews but may limit generalisability of the study if the study population is geographically dispersed or hard to reach. The variation in interview modes and quality of data collected can also depend on how competent participants are in using the modes, the comfort and experiences of both interviewer and participants, and the privacy of the interview setting (7). For example, video conferencing can generate richer data when discussing sensitive topics, where participants can be interviewed in familiar, comfortable settings without the pressure of physical presence of the interviewer.

For the qualitative studies presented in **Chapter Four** and **Chapter Five**, face-to-face interviews were chosen as the best methodological fit to address research aims and generate a richer understanding of the contextual factors influencing the implementation of healthy eating policies and

practices. In the ECEC setting, face-to-face interviews allow for direct observation of organisational and environmental factors such as the layout, physical space, and equipment available to provide food and healthy eating learning experiences to children, and prompt questioning around these factors. Additionally, participants were recruited from centres located in socio-economically diverse areas. Given that participants were not geographically dispersed or hard to reach, face-to-face interviews were feasible and appropriate. Furthermore, the Australian ECEC workforce faces high levels of burnout and stress attributed to increased job demands to complete administrative tasks outside of paid work hours (11). Consultation with a researcher and practitioner with extensive experience in the ECEC sector during the study design indicated that ECEC stakeholders prefer face-to-face discussion. As such, face-to-face interviews were conducted at the workplace to accommodate their time constraints at a location convenient to participants. For ECEC educators and cooks without private offices, face-to-face interviews minimised risk of social desirability bias that could arise if they participated virtually from a shared or director's office.

*Qualitative approach, research paradigm and researcher reflexivity*

The qualitative studies presented in **Chapter Four** and **Chapter Five** are underpinned by an interpretivist approach adopting a constructionist epistemological position, assuming that reality is multiple and subjective, and recognising that knowledge is not an objective reality but co-constructed between researchers and participant experiences (12, 13). A qualitative descriptive approach was used in this research to explore and present findings in a way that closely reflects the multiple and subjective experiences of participants (14). This approach recognises that researcher subjectivity is a resource for knowledge creation and researcher identity and positionality shapes the knowledge produced (15). Researcher's characteristics, including personal attributes, qualifications, experience, and perspectives can influence design, data collection, and data analysis. This section reflects on my role as the researcher in this study and highlights how my subjectivities may influence data collection, analysis, and interpretation of findings.

I identify as an Australian-born Chinese woman, and at the time of this research I was not a parent and had not personally used early childhood education and care (ECEC) services. My interactions with the

ECEC setting have been through my professional role as a dietitian, providing menu reviews and delivering nutrition education workshops to staff and parents. As an Accredited Practising Dietitian with experience working in areas of health promotion in children's populations, my perspective on nutrition in the ECEC setting aligns with the principles of health promotion which aims to build capacity of individuals, strengthen community action, and create supportive environments for health through healthy public policy. This background brings a public health lens to my research, framing the ECEC environment primarily in terms of nutrition and health outcomes and how food practices align with government guidelines.

**Chapter Four** presents a qualitative study using interviews to explore the contextual factors influencing early childhood education director's decisions around implementation of healthy eating policies and practices.

### 4.4 Abstract

Early childhood education and care is an ideal setting to promote healthy eating behaviours in young children. However, successful implementation and sustainment of healthy eating policies and practices remains a key challenge in the Australian early childhood education and care (ECEC) context. This study aimed to understand the contextual factors influencing early childhood education directors' decisions to implement healthy eating policies and practices. Twelve directors from long day care centres in New South Wales Australia participated in semi-structured interviews. Interview data was analysed using reflexive thematic analysis and the Consolidated Framework of Implementation Research. Directors described alignment to centre values and goals, compatibility to work infrastructure, local champions to lead implementation and external partnerships with government support services as key facilitators. Directors identified a need for further support to address factors within the broader ECEC sector. Directors described a lack of external partnerships with the community, competing demands for available resources, unrealistic expectations from guidelines and parents, and inconsistent practices across settings as factors inhibiting implementation.

Implementation and sustainment of healthy eating policies and practices can be improved by strengthening parent and community partnerships, investment in the workforce, and a coordinated approach to provision of support.

**Keywords:** Childcare, Context, Diet, Health promotion, Implementation, Policy, Preschool

## 4.5 Introduction

Early childhood is characterised by rapid physical, social, emotional, and cognitive growth and is a critical period for ensuring children reach their developmental potential (16). Optimal diet and nutrition in early childhood is fundamental for prevention of nutrient deficiencies (17) as well as motor and cognitive development (18) for ensuring school readiness (19). The benefits of early exposure to good nutrition also extends beyond childhood and is associated with healthier diet quality (20) and reduced the risk of cardiometabolic disease later in life (21).

Early childhood education and care (ECEC) centres have been identified as ideal settings for early childhood interventions to promote intake of healthy foods (22). The ECEC setting provides a critical opportunity to reach large numbers of children and foster healthy eating behaviours. In Australia in 2024, 50% of children aged five years or under used early childhood education and care and spent on average 27 hours per week in care (23). Children receive at least 50% of their recommended daily intake while in care (24), which can be influenced by many factors including types and portion sizes of food served, meal service type and feeding practices in the ECEC setting (25).

Recognising the important role that ECEC services play in shaping healthy eating habits, most high-income countries have developed national or jurisdictional regulations and guidelines for the childcare sector, that recommend implementation of a number of healthy eating best-practices (26). Such practices include providing meals aligned with national dietary guidelines, offering nutrition education for children, establishing written nutrition policies, promoting supportive feeding practices, following regulations to respond to and reduce risk of exposure to allergens and creating healthy mealtime environments. However, the implementation of best-practice standards that are consistent

with such guidelines remains poor. For example, an assessment of ECECs in the United States found that centre-based services, on average, implemented only seven out of 15 nutrition practices as recommended by national nutrition standards and guidelines (27). Implementation factors remain a key challenge facing sustained implementation of healthy eating policies and practices in the setting (28).

Adoption, implementation, and sustained delivery of nutrition interventions in the ECEC setting is complex, influenced by multiple factors and stakeholders (29). As such, it is important to understand how context, which describes the circumstances and factors surrounding implementation, can influence and cause variations in desired outcomes (30, 31). Addressing contextual barriers and facilitators surrounding implementation can support the successful translation of research into sustained practice (32). However, early childhood nutrition intervention studies rarely consider the broader environmental and policy context (33).

### *4.5.1 Intervention and policy context in Australia*

In Australia, the ECEC sector is regulated through the National Quality Framework (NQF) which sets national quality standards and learning outcomes to ensure continuous and consistent improvement in ECEC centres (34). Each Australian state and territory are responsible for quality assessment and providing support to centres to meet healthy eating guidelines (34). However, guidelines and support for the implementation of healthy eating policies and practices differs between each state and territory and there have been recommendations for national alignment of food provision guidelines to enable provision of support and resources across jurisdictions (24). Within New South Wales (NSW) the Caring for Children framework was developed to provide practical guidelines on food, nutrition, and learning experiences (35). Additionally, a state-wide government funded early childhood initiative, Munch & Move, is implemented by Local Health District services to support implementation of healthy eating and physical activity within ECEC centres (36). Currently only three out of eight states and territories in Australia have access to funded state-wide nutrition programs.

Adequate implementation of recommended evidence-based healthy eating practices across Australia remain low, particularly for implementation of written nutrition policy, encouraging children to consume age-appropriate beverages, providing healthy eating education to children and families, and providing training and support to educators (37). Over 70% of services were not providing families with child healthy eating education and over 50% of services did not provide educators with adequate training and support to promote healthy eating for children (37). Additionally, only 33% of services meet recommendations for serves of fruit and vegetables and discretionary foods (37). In Victoria, Australia a study found that while government support services improved implementation of menu planning guidelines and menu quality, this did not always translate into menu compliance (2). There remains an opportunity to better understand the factors influencing implementation of healthy eating policies and practices in the Australian ECEC setting to maximise potential benefits for young children.

Challenges to meeting dietary guidelines, achieving healthy food environments, and implementation of nutrition interventions in the Australian ECEC setting have previously been explored; however, existing studies focus on organisational factors such as awareness, skills and confidence of staff within the ECEC setting context (1, 2, 4). There remains a research gap in understanding the broader environmental and policy context and how these factors influence the inner setting, the internal organisational level factors within each service, to inform effective policy level action. Specifically, this has not been explored in New South Wales, one of only three Australian states and territories with access to funded state-wide nutrition programs. This offers useful insights to address the specific challenges faced in this context and inform implementation in other contexts.

Given the multifaceted role directors play in educational programming and management of organisational tasks such as managing staff, overseeing budget, and ensuring compliance with regulations, it is important to understand how they make decisions to implement healthy eating interventions (38). The aim of this study was to understand the experiences of directors regarding how inner and outer setting contextual factors influence their decisions to implement healthy eating policies and practices in centre-based ECEC centres in New South Wales, Australia.

## 4.6 Methods

This study follows the Standards for Reporting Qualitative Research (SRQR) reporting guideline (39). This study was approved by the Sydney Local Health District Human Research Ethics Committee (Project Number X23-0379).

### *4.6.1 Study design*

This study used an interpretivist approach adopting a constructionist epistemological position, recognising that knowledge is not an objective reality but constructed by participant experiences and social context (12). As such, this approach is relevant for the exploration of the complex contextual factors that shape directors' perspectives and decisions.

The authors bring a diverse range of expertise allowing for a richer understanding of director's experiences through the co-construction of meaning from a health perspective to ensure it was applicable to policy and practice while reflecting director's experiences from an education and organisational management perspective. First author JC has prior experience in health promotion and childhood obesity prevention, bringing an understanding of children's food environments. AHP has extensive experience in health promotion and working with ECEC centres. DR, PP, and MAF are experienced researchers, specialising in health promotion research and evaluation, animal and human food environments, and dietetics and public health nutrition respectively.

### *4.6.2 Recruitment*

Purposive sampling was used to recruit directors from Sydney and South Eastern Sydney Local Health Districts, located in areas with ethnically diverse populations. Directors who were currently employed at long day care centres providing morning tea, lunch, and afternoon tea were eligible for the study. Directors were invited to participate by Local Health District Health Promotion Services who have an existing relationship with local ECEC centres, providing support to implement the statewide 'Munch & Move' initiative. Health Promotion Service staff distributed the invitation letter, participant information sheet, and recruitment flyer through emails, e-newsletters, workshops and a Facebook page. Data quality was reviewed during data collection and recruitment stopped when

adequate information power was reached (40). Given the specificity of the research question, use of the established CFIR framework to guide semi-structured interview questions, and sample of experienced and qualified directors (Table 4.1), we determined the sample size of 12 participants provided sufficient insight to generate an in-depth understanding of the factors influencing healthy eating policy and practice implementation (40, 41). Participant characteristics are presented in Table 4.1.

### *4.6.3 Data Collection*

Semi-structured interviews were chosen for data collection to allow for focused exploration of contextual factors within a limited timeframe, recognising the busy schedules of directors. Face-to-face interviews were selected as the most appropriate approach to generate richer discussion of contextual factors and enabled interviews to take place at centres at a time and location convenient and comfortable for centre directors. A semi-structured interview guide was developed informed by the Consolidated Framework of Implementation Research (CFIR). The CFIR proposes a set of specific and detailed constructs in the Inner setting domain to explain organisational factors and Outer setting domain to explain the broader factors influenced by where the organisation is placed in the community, political and economic environment (42). The CFIR has previously been used in the childcare and school setting to assess barriers and facilitators to healthy eating and obesity prevention programs (5, 43-45).

The semi-structured interview guide consisted of seven open-ended questions to allow for open exploration of contextual factors as well as prompts to explore factors outlined by CFIR (Supplementary File 1). The guide was pilot tested with an ECEC director not included in this sample before use and the ECEC director agreed that all questions were appropriate and relevant. All interviews were conducted by the first author (JC) at the ECEC centre where directors were employed. Participants provided informed written and verbal consent prior to participation. The interviews were audio-recorded using Zoom software. Audio recordings were transcribed verbatim in Microsoft Word following the interviews. Each participant was assigned a research project identifier to store data and maintain privacy and confidentiality. Twelve interviews were conducted between

December 2023 and April 2024. The duration of the interviews ranged from 20 to 67 minutes, with a mean of 35 minutes. Participants were provided with an AUD $30 gift voucher as reimbursement for their time.

### *4.6.4 Data analysis*

Reflexive thematic analysis is well-suited to a constructivist perspective as it emphasises the role of the researcher in the co-construction of knowledge (15). The flexibility of this approach allowed authors to use CFIR to deductively map contextual factors while inductively engaging with the data to generate themes relevant to the ECEC context. The six-phase process as described by Braun and Clarke was used (46). One data coder (JC) read through all transcripts to familiarise with the data. Transcripts were first open-coded by JC to allow for deeper engagement and interpretation of the data. This was followed by a second level of coding using CFIR to inform new codes and articulate specific concepts. The codes from two transcripts were reviewed by a second coder (MAF). Discussion between the two data coders allowed for refinement and addition of codes from a different perspective to provide a more nuanced interpretation of the data. One data coder (JC) then analysed codes to generate candidate themes and sub-themes from the data. Candidate themes were refined by reviewing all the collated extracts theme and re-reading the entire data set to ensure codes and themes fit the data set. Themes were reviewed to define the central organising concepts and named. Data was managed and analysed using NVivo 14.

**Table 4.1.** Demographic characteristics of participating directors and centre characteristics (*n* = 12).

| Director characteristics | n (%) |
|---|---|
| **Gender** | |
| Female | 12 (100) |
| **Age** | |
| 18-29 years | 2 (17) |
| 30-39 years | 6 (50) |
| 40-49 years | 3 (25) |
| 50-59 years | 1 (8) |
| **Highest level of education** | |
| Degree (Bachelor, Masters, Doctorate) | 10 (83) |
| Graduate or Advanced Diploma | 2 (17) |
| **Country of birth** | |
| Australia | 6 (50) |
| Other † | 6 (50) |
| **Centre characteristics** | **n (%)** |
| **Number of children enrolled** | |
| Range (n) | 35 – 98 |
| Average (n) | 62 |
| **Service provider type** | |
| For-profit | 9 (75) |
| Non-profit | 3 (25) |
| **Food preparation** | |
| All meals cooked on-site | 9 (75) |
| All meals are outsourced | 1 (8) |
| Mixed | 2 (17) |
| **Socio-Economic Status (SEIFA 2021)** ‡ | |
| Most disadvantaged | 0 (0) |
| Most advantaged | 12 (100) |

† China, Italy, Ireland, Mauritius, Pakistan, Philippines

‡ ISRAD Quintile: Index of Relative Socio-economic Advantage and Disadvantage (ISRAD) provides a measure of advantage and disadvantage based on economic and social conditions, such as income and occupation, of people and households within a geographical area. A high score indicates a relative lack of disadvantage and greater advantage. Most disadvantaged = quintiles 1-3. Most advantaged = quintiles 4-5.

**Table 4.2.** Overview of the themes describing contextual factors influencing director's decisions to implement healthy eating policies and practices in centre-based early childhood education and care services.

| Themes | Sub-themes | Overview |
|---|---|---|
| 1. Inner Setting factors | 1.1. Healthy eating "just happens"<br>1.2. Navigating competing priorities<br>1.3. Supportive work infrastructure | *Inner Setting factors* captures the barriers and enablers at the organisational level within ECEC services. Directors described implementation of healthy eating experiences was described as something that "just happens". Competing priorities for available resources such as funding and staff time was described as a barrier. Supportive work infrastructure was described as a facilitator. |
| 2. Outer Setting factors | 2.1. Satisfactory implementation support<br>2.2. Regulations vs reality<br>2.3. Parent vs partnership<br>2.4. Fragmented systems of support | *Outer Setting factors* captures the barriers and enablers at the system level across the ECEC sector. In the context of NSW, Munch & Move was identified as a key facilitator. External pressure from nutrition guidelines, the local attitudes of parents, and local funding conditions were identified as barriers. |

## 4.7 Results

Two key themes and seven sub-themes were developed relating to how directors described the influence of contextual factors on decisions to implement healthy eating policies and practices (Table 4.2).

### *4.7.1 Theme 1: Inner Setting factors*

*Healthy eating "just happens"*

Directors described shared values and goals around supporting children's needs and described, providing healthy nutritious food as an "important part of our existence" (Participant 39). Directors recognised that many families were time poor and may not be able to provide nutritious meals at home. As children were spending long hours in childcare, directors expressed fulfilment in providing nutritious food.

Outside of food provision, director's descriptions of their role in implementing healthy eating policies and practices were less consistent. Some explained that healthy eating was included as part of the centres programmed curriculum alongside science, maths, and literacy. For others, healthy eating learning experiences were seen as important extracurricular, that is "part of" but not a core aspect of the curriculum.

> "I would probably say that educators probably think more the core is more like social and emotional and things like that" (Participant 24, non-profit centre)

Directors described leveraging other learning opportunities to integrate healthy eating. For instance, participant 14 described implementing excursions to native gardens as an opportunity for nutrition education, to support the indigenous community, and talk about "caring for the earth as well". Directors also described other opportunities to integrate healthy eating while "also teaching them science" (Participant 12) and developing children's sensory perception and motor skills. Many described school readiness programs as a good opportunity to include healthy eating through lunchbox activities.

Directors often described healthy eating practices occurring organically and as needed. Directors felt that there were many opportunities for healthy eating learning experiences through discussions at mealtimes and daily conversations.

> "I wouldn't say there's a set time. There's obviously daily spontaneous conversations, but if it does come up […] we'll plan a follow up experience." (Participant 19, for-profit centre)

Directors expressed that allowing staff to plan healthy eating learning experiences based on their interest increased staff motivation and facilitated implementation. Healthy eating learning experiences were also prompted by cultural celebrations and food related events throughout the year, or planned in response to educator, child or family interest. Participant 24 compared implementation of practices such as talking about healthy eating as something that "happens a lot" and "just happens" compared to physical activity which needed to be "planned intentional like things that we focus on" to fulfill specific fundamental movement skill outcomes.

Directors expressed they were content with the way healthy eating policies and practices were currently being implemented and agreed informal practices were working well within their centres. When asked if any changes to internal practices were required, directors often expressed little need for change. Directors noted that because their nutrition policy was "not very big […] it just talks about children, healthy eating, [and providing a] nutritious menu" (Participant 24) and nutrition experiences occurred sporadically, they did not feel there were many restrictions or barriers to implementation.

> "So obviously we wouldn't be talking about nutritional planning, nutrition experiences every day or even so every week, it might just be sporadically, you know, throughout the year. So I don't feel that there's very many barriers" (Participant 19, for-profit centre)

*Navigating competing priorities*

Directors articulated many complexities and competing priorities around food provision. Directors frequently commented on food allergies and anaphylaxis suggesting this was at the forefront of planning and practice. Directors described challenges meeting nutrition guidelines while managing allergies. For example, participant 3 commented, "the nutritional value of an egg is gone for the whole

service, so it's very hard". Providing opportunities for children to make their own choices around food was frequently noted as an important value which directors described as a challenge to managing fussy eating. Other competing priorities described included minimising food wastage, ensuring quality of food, and food safety and hygiene.

Directors frequently commented on the competing demands for available financial resources including the increasing costs of food, mandatory staff training requirements, and staff wages.

> "So the cost of living is rising too much, so that is one of the things that we are getting conscious of […] We did have children with soy allergies, so definitely there is another type of bread for them. So again, it's cost, cost, cost added to it." (Participant 1, for-profit centre)

> "There's big pressure to bring costs down and wages are going up and there's staffing crisis at the moment […] People are using staff from agencies which are costing a lot […] and I think they're cutting corners a lot in terms of healthy eating and nutrition" (Participant 39, non-profit centre)

While both for-profit and not-for-profit centres noted competing priorities for funding, directors from for-profit centres reflected that "it always comes down to money" (participant 25) and some explained costs were passed onto families through increased fees. Other directors, from both for-profit and not-for-profit centres, applied for external grants which enabled centres to prioritise healthy eating and support implementation of interventions. However, securing external grant funding was challenging as opportunities were scarce and a lot of paperwork was required.

Directors acknowledged staffing shortages across the ECEC industry, however, most directors in this study described low staff turnover and dependable staff within their own centres. Directors noted when staff time was limited or staff were absent, available time was usually prioritised for immediate tasks, such as ensuring the safety of children and preparing simple meals, rather than implementing healthy eating learning experiences or preparing meals planned on the menu. Some centres decided to use catering services to overcome challenges related to staffing, ensuring children were provided with fresh and nutritious food and reducing food safety and allergy risks in the absence of trained staff.

*Supportive work infrastructure*

Directors who expressed confidence in their own and their staff's capabilities often reported having adequate access to available resources. Directors described company support including in-house dietitians, company-wide training for staff, and funding for mandatory training. For those part of a larger company, there were internal networking opportunities for directors and staff to support each other such as Whatsapp group chats. Some also noted flexibility within the budget for food and flexibility to implement policy and practices according to local conditions. Some directors noted that the organisation of tasks and responsibilities within their team enabled learning experiences to be planned if an opportunity "pops up" (Participant 48). For example, chefs providing recipes or organising ingredients for educators to deliver cooking experiences.

For some, the ability to rely on informal practices was facilitated by local champions. Directors described implementation of healthy eating practices were driven by passionate staff committed to providing high quality food and new learning experiences.

> "You couldn't replicate this everywhere. I think if you had high turnover and just say [the cook] was to retire and and the person you replaced her with wasn't as passionate it could be a completely different." (Participant 39, non-profit centre)

Some directors noted staff were adaptable and flexible to fit changing needs and processes in place such as regular team feedback to resolve issues. Some cited that their experience in the industry was a key facilitator to overcoming challenges reflecting that "the only barrier is you know how much you push yourself" (Participant 14).

### *4.7.2 Theme 2: Outer Setting factors*

*Satisfactory implementation support*

Directors felt like they had access to support from a state-wide government support service, Munch & Move, to implement policy or practices according to guidelines. Directors cited Munch & Move as the primary resource for healthy eating, including workshops for staff, written materials for parents, and

resources to support staff to deliver learning experiences to children. Directors felt most supported for menu planning through Munch & Move, which assesses centre menus against the NSW nutrition guidelines and provides a certificate of compliance. Directors noted the approval process and certificate as incentives to plan and maintain healthy menus. Some directors noted that the government support service was more than just a resource for information, they felt that the relationship and trust with Munch & Move support officers was a facilitator to implementation. One director expressed that they felt more comfortable reaching out to Munch & Move than approaching their company head office for support.

> "So it's not just sending our stuff in the mail. Like we have a great connection with them, so it's really good trust." (Participant 14, for-profit centre)

*Regulations vs. Reality*

Some directors expressed external quality standards and guidelines related to food and nutrition were necessary to safeguard the ECEC industry and ensure high quality care. For others, policies and guidelines were an obligation. Directors described they had a duty of care to children and families to follow them and "tick all of those boxes" (Participant 19).

External nutrition policies and guidelines were constructed as unrealistic. Some directors noted the requirements for vegetables were excessive leading to food wastage and higher food costs. Some directors also felt that the requirements for healthier alternatives were too costly.

> "And we've tried to take this suggestion on board, and often it leads to a lot of food wastage […] Even though we sat with children and role model and involve them in the process." (Participant 12, non-profit centre)

*Parent vs Partnership*

Directors expressed concerns about the differences in practices between the home and the ECEC food environment and how this could potentially "confuse children" (Participant 16). Directors described discrepancies were attributed to lack of parental nutrition knowledge, differences in cultural values, or for others, directors noted families were time poor and tight on money.

Directors expressed communication with parents was important for building partnerships between ECEC and families. Directors also noted the importance and responsibility of ECECs to support families with healthy eating practices at home. This included documenting healthy eating learning experiences and sharing with parents, organising parent evenings, distributing newsletters and information sheets, and sharing links to workshops. However, some directors reflected there was little engagement from parents and as such felt limited in what they could do to support families.

> "Yes, but we need to honour whatever the parents decide. And that is a bit of a barrier because we can try and talk to them, but at the end of the day they can make their choices for their child." (Participant 22, for-profit centre)

Directors also described facing parental pressure to manage fussy eating behaviours and cater to family preferences. Some directors felt that they had to honour parents' wishes despite going against recommendations and guidelines, creating a tension between trying to please parents and meeting policies and guidelines.

> "I have had a few comments from families that there's a lot of red meat, but that comes from the recommended guidelines from NSW Health" (Participant 19, for-profit centre)

Some directors expressed frustration at trying to meet parents preferences for homemade baked goods, while trying to meet feedback from Munch & Move support officers to reduce baked goods.

> "We had a complaint where they said nothing was homemade and then we changed the menu with all homemade and then we check […] with Munch & Move, they said you can't have everything baked […] I'm like, Oh my God, it's hard to like please everybody […] but you know, we're not the Hilton and we're not going to be providing like, gourmet every day." (Participant 3, for-profit centre)

Directors expressed the need for more information and resources to support families, particularly for first time parents. Some suggested more support is needed to implement "hands-on" healthy eating interventions that involve the home environment such as an app or workshops for families. Directors noted there was an existing relationship with local council and reflected on the successful

implementation of environmental sustainability programs. Following the success of these interventions, directors recommended aspects of healthy eating and nutrition should be incorporated.

*Fragmented systems of support*

Systems to support implementation of healthy eating policy and practice was constructed as inadequate to support the ECEC sector. Directors expressed that they were interested in more information and new ideas for how to implement healthy eating policies and practices, however, noted it was challenging to stay up to date with available resources. Directors described resources were scattered and recommended a directory or service to support directors to locate current resources. Directors noted that they often rely on their own research and internal support to stay up to date with new information, resources and funding opportunities.

> "It's very time consuming […] it's Googling, it's looking for them […] But for something like that I wouldn't even know where to look. So, I have support with the parent management committee to sometimes help me lock down grants." (Participant 39, non-profit centre)

Directors felt that the National Quality Standards (NQS), which centres are required to meet, were "not extremely specific like NSW Health [Caring for Children guidelines]" which provide guidance on how to meet the NQS. As such, centres could "interpret [the NQS] the way that they wish" (Participant 19). However, there was a tension between the ideal of implementing more specific guidelines for consistency across the ECEC sector and the reality of implementation. Directors reflected on the lack of external partnerships and connections with the community. Directors also expressed concerns that new staff had inadequate nutrition education during their early childhood educator training. Directors described limited ongoing professional development opportunities and recommended funding for online modules or workshops to support staff. Furthermore, directors felt there was a lack of funding and nutrition education to support the challenges faced by the ECEC industry such as staff shortages.

> "We already have enough guidelines, enough regulations, we just don't have the funding, or the education for it. So, yeah, those are the big issues because like, yes, you can add the regulation, but that's not going to change anything." (Participant 22, for-profit centre)

## 4.8 Discussion

The current study identified the contextual factors influencing ECEC director's decisions to implement healthy eating policies and practices. Directors described supportive inner setting factors including strong culture of shared values and goals to support children's growth and development, work infrastructure to organise tasks and responsibilities for staff, as well as having a local champion to lead implementation. However, directors noted that competing demands on resources, such as centre funding and staff time, were a key barrier. Directors also acknowledged outer setting partnerships with Local Health District services to support implementation of healthy eating guidelines. Directors often described outer setting factors inhibiting implementation including lack of external partnerships with the community, unrealistic guidelines, discrepancies between parental preferences and nutrition guidelines and inconsistent practices at home. Directors expressed that local conditions were not supportive, citing workforce and funding issues across the ECEC sector.

Within the inner setting, directors described a complex environment of competing demands for available resources to implement healthy eating policies and practices. A previous study found that implementation was less likely if healthy eating was perceived as less important compared to other priorities (5). Opportunities to use programs to meet multiple curriculum requirements and ability for these programs to 'fit' within existing workflows and systems can facilitate implementation and sustainability of nutrition and physical activity interventions in the ECEC setting (47). Given competing demands, strengthening connections between healthy eating and the learning outcomes at the forefront of planning and practice may better align with director priorities and support implementation. Consistent with previous research, supporting a program champion to lead implementation can promote sustained delivery of healthy eating policies and practices (48).

However, robust systems and processes are essential to ensure continuity if there are changes in management or champions.

Consistent with previous research, directors described many informal opportunities to implement healthy eating practices (1). However, studies conducted in NSW and Victoria Australia suggests current healthy eating environments and practices do not align with best practice guidelines (49, 50). Directors may not always express the need for change if not aware of how and why healthy eating practices should be implemented (51). Additionally, weak nutrition policies that are not tailored to centres and lack adequate detail may result in poor implementation of healthy eating practices (1, 50). It would be in the best interests of children if there was a national agreement to set clear objectives regarding food provision and healthy food environment outcomes to ensure consistent interpretation across the ECEC sector. However, findings from this study suggests further investment in resourcing is needed to support the implementation of stronger nutrition standards. For example, in the United States, ECEC centres receiving CACFP subsidies for serving healthy meals, reported fewer barriers to implementing new healthy eating policies (52). Similar to CACFP, introducing a funding model in Australia that requires centres to meet nutrition guidelines as a condition of receiving support may improve compliance with nutrition standards and promote healthier food environments.

The sustained implementation of healthy eating policy and practices depends on key outer contextual factors including having a policy or guideline from a governing body, alignment with the broader community such as parents, and external partnerships (53). In this study, state guidelines were perceived as unrealistic and challenging to meet, failing to acknowledge the competing demands and complexities of the setting. Implementing initiatives that address contextual barriers can improve compliance with standards and guidelines. In the United States, ECEC centres receiving healthy food subsidies reported fewer barriers to implementing new healthy eating policies (52). While many directors were “lucky” with their staff, directors expressed the need to fix underlying issues with the ECEC workforce, such as poor staff retention and insufficient nutrition knowledge, before making changes to the rules and regulations. Staff shortages and turnover in the Australian ECEC context has been well described and attributed to high demand, low staff wages, poor work conditions and lack of

recognition (54). Dependable staff have been found to be important facilitators in this study and others (47), emphasizing the need for long term investments from national and subnational budgets to ensure a skilled ECEC workforce that meets the level of demand (26). Nutrition training should be standardised and mandated for all ECEC staff by embedding comprehensive nutrition and responsive feeding content in early childhood education qualifications and providing ECEC specific nutrition training for cooks.

Previous research suggests that ECEC centres are more likely to implement healthy eating interventions when they have parental support (5). However, similar to the findings of this study, parental disengagement and inconsistencies between home and ECEC settings are common challenges within the ECEC context (1, 51). Effective workflow designs that promote regular communication and collaboration with parents are key to addressing disengagement (47, 55). Inclusion of resources to support staff to communicate and collaborate with parents through existing ECEC nutrition support services and programs can improve parent partnerships (56). To support this, existing programs like Munch & Move (NSW) and Healthy Eating Advisory Service (Victoria) could be expanded to include family engagement components. Directors in this study recommended home-based learning activities, workshops and a digital tool such as an app for families. Policy incentives could encourage ECEC services to promote parent engagement and improve healthy behaviours across home and ECEC settings. For example, in the United States, the Child and Adult Care Food Program (CACFP) is a federally funded initiative that ties funding for meal subsidies with standards which require ECEC services to communicate with parents about child nutrition (57).

Networks and partnerships with external organisations have been identified as important facilitators to supplement available resources and provide partners for the implementation of healthy eating activities (5, 47). In the current study, directors described external partnerships with local health services through the *Munch & Move* initiative was a key facilitator to implementation. Directors also expressed a need for a more community partnerships as well as a coordinated system to access information, suggesting greater input from local council. Local councils are well-placed to provide support to improve implementation of healthy eating interventions in ECECs given their role in the

community and transforming the local food system (58). Multisectoral partnerships can provide a more coordinated approach to support directors in their role to implement healthy eating policies and practices (26). Given that only three of the eight Australian jurisdictions provide state-funded support services, there is an opportunity for other jurisdictions to strengthen implementation by establishing multisectoral support that integrates local health services, local councils, and ECEC regulatory authorities.

Despite the "workforce crisis" (54), staffing was rarely identified as a barrier, possibly reflecting a skewed sample. Additionally, while recruitment included directors from socio-economically diverse areas, only directors from centres in the most advantaged areas volunteered to participate. This may be because directors facing staffing challenges and inequity likely lack the time or capacity to participate. Director experiences were similar to those described in recent studies from other jurisdictions within Australia (1, 2), however, we acknowledge this study may not capture all experiences and contextual factors across the wider ECEC setting. Although this study did not identify substantial differences between for-profit and not-for-profit centres, a previous cross-sectional study has found higher implementation of healthy eating policies and practices in private for-profit services (49). Future qualitative studies to examine the differences in contextual factors between for-profit and not-for-profit services and understand how service provider type impacts implementation is warranted to inform how best to tailor implementation support. Further research to understand the unique contextual factors experienced by disadvantaged populations, across jurisdictions, and other ECEC centre types such as family day care is recommended to inform policy and practice that consider the multiple and varying experiences of directors in different contexts. A strength of this study is that it used an inductive approach to allow for deep engagement with the data and flexibility to identify contextual factors while being informed by the CFIR.

### 4.9 Conclusion

This study provides a greater understanding of contextual factors influencing director's decisions to implement healthy eating policies and practices in the ECEC setting. Inner setting contextual factors including alignment of goals and values, fit within work infrastructure, and implementation leads

were identified as facilitators. External partnership with government support services were identified as an enabler within the context of NSW Australia. The study identified need for further support to navigate outer setting contextual factors impeding implementation. The ECEC setting may benefit from strengthening parent and community partnerships, investment in the workforce, and a coordinated approach to provision of support. A combination of "upstream" national policy actions to improve outer contextual factors and "downstream" approaches that focus on inner setting factors is recommended.

## 4.10 Conclusion to chapter

This chapter examined the contextual factors that influence implementation of healthy eating policies and practices and provides a better understanding of how we can address environment and policy level determinants in the ECEC setting. This study explored the experiences and contexts of ECEC directors who play an important role in making decisions around policy implementation, planning of programs, and management of organisational tasks. Directors identified lack of supportive "outer setting" policy level action as barriers to implementation. These contextual barriers included lack of parent and community partnerships, workforce challenges, and fragmented systems of support. Directors identified *Munch & Move*, a government funded support service available in NSW, the state where the sample was drawn from, as a key facilitator to implementation of healthy menu planning practices and support to meet dietary guidelines. The findings from this chapter revealed that policy level action is needed to strengthen external partnerships across health, education, and local government sectors, expand government-funded implementation support to include family engagement components, standardise and mandate nutrition training for all staff, and improve availability of sector funding to support implementation of healthy eating policies and practices. **Chapter Five** will use qualitative methods to explore the contextual factors that impact how educators and cooks deliver healthy eating practices.

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## 4.12 Supplementary material

**Supplementary file 1: Semi-structured interview guide**

**Note**: Prompts have been provided to help guide the interview and probe for more information if needed, however, **not all prompts will be asked**.

**Introduction:**

- Thank you for participating in this interview. Introduce interviewer and their role.
- In this interview, I want to ask about your expert experience and knowledge as a director/educator/cook and understand what has helped or hindered your service to deliver and continue to provide healthy eating activities.
- The interview will take about 30-40 minutes and will be audio recorded. Your answers will then be written as notes and sent back to you for comment and/or correction. The recordings and written notes will be stored securely and used only for the purpose of this study.
- All information you provide will be confidential and you will not be identified by name in any report.
- Participation in this interview is voluntary. You are not required to answer any questions that make you feel uncomfortable. You are free to withdraw from participation at any stage.
- By participating, you are telling us you understand what you have read in the participant information sheet and consent to take part in an interview and for this information to be used in this study.
- Please ask questions about anything you don't understand or want to know more about. Do you have any questions before we begin?

To begin with, could you please briefly tell me about your role in the service?

- What is your role around food (e.g. preparation, food service, menu planning)?
- How many years of experience do you have working in early childhood education and care?

Thank you. I will now move on to some questions that will help us understand what helps or hinders your service to provide healthy eating.

| **CFIR Domain** | **Objectives** | **Interview questions: Directors** |
|---|---|---|
| **Context** | To identify interventions currently being implemented | 1. Can you tell me about any food or nutrition policies/guidelines, practices or programmes that are currently provided at your service?<br>a. What do you like?<br>b. What do you dislike? |
| **Innovation** | To identify the components of the innovation that enable and/or inhibit implementation and sustainment of nutrition interventions. | 2. What features would you need to continue, improve, or discontinue?<br>*Prompts:*<br>- What would you change and why? What would you keep and why? |
| **Inner setting** | To identify the inner setting organisational barriers and enablers to implementation and sustainment of nutrition interventions. | 3. How does providing a nutrition policy, practice, or programme fit in with the priorities of your service?<br>*Prompts;*<br>- What are the values/beliefs around nutrition?<br>4. Tell me about the resources available in your service for prioritising nutrition policy, practices and programmes.<br>*Prompts:*<br>- How does staffing influence how your service prioritises nutrition?<br>- How does cost/budget influence your service to prioritise nutrition?<br>- What are the workflows/processes that influence how you prioritise nutrition at your service.<br>- What are the communication strategies between management, educators, cooks, and families at your service to support healthy eating. |

| | | |
|---|---|---|
| | | 5. What resources do you need to continue to provide it? |
| **Outer setting** | To identify the outer setting barriers and enablers to implementation and sustainment of nutrition interventions. | 6. Tell me about the factors outside the control of your service that influence your decision to provide a nutrition policy, practice, or programme?<br>*Prompts:*<br>- How is your decision influenced by external funding? (e.g. subsidies, re-imbursements, grants from government or non-government organisations or lack thereof)<br>- How is your decision influenced by external policies or guidelines?<br>- How is your decision influenced by national quality benchmarks/ accreditation standards?<br>- How is your decision influenced by external entities (e.g. professional networks, government or academic organisations, community partners)?<br>7. What external support do you have/would you need to continue to provide it? |

**Close of the interview:**

Is there anything else you would like to add?

If you experience any discomfort or distress from the interview, please refer to the Participant Information Sheet for support services that you can contact.

Thank you for participating in this interview today, we really value your insight and appreciate your time. I will email you a summary of the results of this study once they are ready if you have requested this in your consent form.

# Chapter Five: Beyond local champions: Contextual factors shaping the implementation of healthy eating interventions in centre-based care – A qualitative study with educators and cooks

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## 5.1 Publication details

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The layout, terminology and English language is in accordance with journal requirements. Referencing in this chapter has been changed to be consistent with Vancouver referencing style.

## 5.2 Author contributions

JC, PP, DR and MAF were involved in the conceptualisation and design of the study. JC and AHP were involved in participant recruitment. JC led the data collection and analysis. JC prepared the

initial draft of the manuscript, and all authors were involved in review and editing of the final manuscript.

## 5.3 Introduction to chapter

Findings from the scoping review presented in **Chapter Two** and **Chapter Three** identified leverage points in addressing environment and policy level determinants to improve children's diets, particularly in the ECEC setting where most early childhood nutrition interventions are conducted. Understanding the contextual factors influencing implementation of healthy eating policies and practices can inform interventions to address these environment and policy level determinants.

**Chapter Four** explored the perspectives of early childhood directors and identified key inner and outer setting barriers and facilitators. Within the inner setting at the organisational level, directors described competing priorities for available resources such as funding and staff time as a barrier and having supportive work infrastructure as a facilitator. In the outer setting at the systems-level, implementation support from a state-wide healthy eating initiative, Munch & Move, was identified as a facilitator. Pressure to meet nutrition guidelines, parent expectations and preferences, and inadequate funding, nutrition education, and community partnerships were identified as barriers. In this chapter, qualitative methods were used to explore the perspectives of early childhood educators and cooks given the important role they play in the delivery of healthy eating interventions in the ECEC setting.

## 5.4 Abstract

*Issue addressed*

The early childhood education and care (ECEC) setting provides a critical opportunity to reach young children and families to support optimal nutrition and development. Despite the abundance of health eating interventions delivered in this setting, the most effective ways to improve children's diets remains unclear. These efforts are hindered by our limited understanding of the complex set of factors that influences the successful implementation of healthy eating interventions. This study aims to

explore early childhood educator and cooks' experiences of the contextual factors influencing implementation of healthy eating policies and practices.

*Methods*

A qualitative study using semi-structured interviews was conducted with four educators and six cooks from ten centres located in New South Wales, Australia. The Consolidated Framework of Implementation Research was used to guide data collection. Data were analysed using reflexive thematic analysis.

*Results*

Educators and cooks expressed commitment to implementing healthy eating policies and described support from directors and local health services. However, ECEC sector conditions inhibited implementation. Barriers to implementation included inadequate collaboration between management, educators, cooks, and parents, limited opportunities for partnerships and networking within the ECEC sector and beyond, and insufficient nutrition education and training.

*Conclusions*

Addressing broader systems-level factors by strengthening work infrastructure, partnerships, and nutrition education and training opportunities is necessary to improve implementation of healthy eating policies and practices in the ECEC sector.

*So what?*

Findings can inform policymakers to consider barriers faced by ECEC staff in implementing healthy eating interventions.

## 5.5 Introduction

Early childhood is an important period of rapid growth and development and plays a crucial role in shaping lifelong habits (1). During these early years, establishing optimal diet and nutrition is pivotal

for cognitive development and physical growth (2). It is also an important period for establishing healthy dietary patterns that track into later life and reducing future risk of obesity and chronic disease (3, 4). Despite the evidence outlining the protective effects of healthy diets, Australian children are not meeting national dietary guidelines (5). As such, there is increasing urgency to implement effective initiatives to improve child dietary outcomes and reduce obesity risk.

Early childhood education and care (ECEC) is a powerful setting for promoting healthy development and eating habits in early years. ECEC attendance is associated with better language skills, academic achievement, and reduced risk of poverty in adulthood (6, 7). In Australia, preschool programs are planned educational programs delivered by an early childhood teacher in the year before they start full-time school. Following major policy reforms implemented in 2008 to increase access to preschool programs, the number of Australian children attending preschool, including programs provided by centre-based long day care, has grown (8). In 2024, almost 60% of Australian children attended centre-based day care and spent on average 27 hours in care per week (9). Given the number of children in attendance and long hours in care, centre-based ECEC services provide opportunities to improve children's eating behaviours and diets.

The majority of studies investigating effectiveness of interventions to optimise children's diets have been conducted in the ECEC setting (10). However, the effectiveness of ECEC-based healthy eating interventions remains unclear (11). Interventions show favourable results for fruit intake, but there appears to be little to no effect on the consumption of vegetables, energy-dense nutrient-poor foods, and sugar-sweetened beverages (11). Support strategies such as providing educational materials, audit and feedback, incentives, reminders and tailored advice, may improve intervention implementation, but these strategies did not translate to better child dietary outcomes (12). Implementation issues can attenuate the potential benefits of evidence-based healthy eating interventions on children's dietary outcomes in the real world (13).

In Australia, the implementation of healthy eating practices in the ECEC setting is varied and some practices remain poorly implemented (14). Research suggests that long day care centres providing food on site are not meeting menu planning guidelines (15, 16). The *National Quality Standards* set

quality benchmarks which state that healthy eating be "promoted and appropriate" for children (17). However, there is limited support to operationalise the standards for healthy eating. The national Get Up & Grow guidelines and resources provide guidance on how to implement healthy eating policies and practices in the ECEC setting but have not been updated since 2013 (18). Furthermore, food provision guidelines vary across each state and territory. In New South Wales (NSW), the state-funded *Munch & Move* initiative is delivered by local government health services to support implementation of state specific best practice guidelines on healthy eating and nutrition for the ECEC setting (19). However, only three out of eight jurisdictions provide state-funded programs (20). As such, there have been calls for a national coordinated approach to provide support to ECEC services to implement healthy eating policies and practices (20). Given the differences in guidelines, support and resources, it is important to gain a systems-level understanding of how the various factors interact to influence implementation across jurisdictions within Australia.

The ECEC setting is shaped by a complex set of influences, many of which pose challenges to implementing and sustaining healthy eating policies and practices. A substantial body of research has examined the barriers and enablers to implementing healthy eating policies and practices in the ECEC setting (21). Qualitative studies to investigate the barriers and enablers to a health-promoting food environment (22), menu planning guideline implementation (23), and factors influencing food service provision (24) have been previously conducted in Queensland, Victoria, and South Australia, respectively. In New South Wales, factors influencing the implementation of healthy eating policies and practices have been previously explored, however, these studies use a deductive quantitative approach which may limit insight into specific barriers related to implementation and overlook important factors (25-27). Notably, most of these studies have applied the Theoretical Domains Framework which focuses on describing 'inner setting' factors such as knowledge, skills and beliefs at the individual level, social influences at the interpersonal level, and environmental context and resources at the organisational level.

Our understanding of the 'outer setting' such as the sociocultural values and economic, environmental and political conditions within the broader systems in which ECEC services operate remains limited.

Addressing these broader influences is essential for the development of effective, system-level policy interventions. For example, in the United States, the Child and Adult Care Food Program reduces financial barriers by providing free or subsidised meals to children in low-income communities, with participating centres reporting fewer implementation challenges compared to non-participating centres (28). Given that health and nutrition support in Australia is state-based, and the level of support varies across states, it is important to understand contextual factors within each state. In NSW, where the state-funded healthy eating program exists, further qualitative research into system-level influences on policy implementation could also inform support strategies in the ECEC setting across other jurisdictions.

Within the ECEC setting, ECEC staff play a critical role in providing a safe environment to meet children's health and nutritional needs and nurture healthy eating habits. Particularly important are early childhood educators and cooks. Educators can shape the dietary behaviours of young children through modelling healthy eating, providing nutrition education, and reinforcing positive behaviours during mealtimes (29), while ECEC cooks or chefs play an integral part in the planning and preparation of meals, as well as exposing children to food through health promoting menus (24). Both educators and cooks are directly responsible for the day-to-day delivery of nutrition-related policies and practices and key end-users of healthy eating interventions. However, Australian research has predominantly focused on directors and cooks, with limited attention to educators' perspectives. Exploring and comparing the experiences of both educators and cooks are integral to understanding the contextual factors influencing delivery of healthy eating policies and practices at the organisational level and how broader system-level factors influences implementation across roles. This can inform the co-design of support strategies that are relevant for those delivering healthy eating in practice (30).This study aims to add to the body of evidence and understand how best to address factors influencing implementation of healthy eating policies and practices from the perspectives of early childhood educators and cooks in New South Wales, Australia.

## 5.6 Methods

The researchers followed the Standards for reporting Qualitative Research (SRQR) reporting guideline (31). This study was approved by the Sydney Local Health District Human Research Ethics Committee (Project Number X23-0379).

### *5.6.1 Qualitative approach and paradigm*

This study is underpinned by an interpretivist or social constructivist paradigm assuming that reality is multiple and subjective, and meaning is shaped by past experiences and social context (32, 33). A qualitative descriptive approach allowed authors to explore and present findings in a way that closely reflects the multiple and subjective experiences of participants (34). This approach is relevant to construct meaningful and nuanced accounts of how context influences experiences of educators and cooks and better understand the complexities of implementing healthy eating policies and practices unique to the ECEC setting.

All authors are experienced in nutrition and health program design, implementation and evaluation and bring a health promotion perspective to the study design, data collection and analysis. The co-construction of knowledge brings together participants perspective of their experiences in early childhood education and researchers health perspectives to inform policy and practice recommendations to support healthy eating in the ECEC setting.

### *5.6.2 Recruitment*

Early childhood educators and cooks currently employed at a centre-based ECEC service providing food to children were eligible to participate. As we were interested in exploring the different experiences with external factors such as local community conditions, we used purposeful sampling to recruit participants from ECEC services located across central and south eastern Sydney where there are ethnically diverse communities. Educators and cooks were invited to participate by representatives from Local Health District Health Promotion Services who have an existing relationship with ECEC services through the *Munch & Move* initiative. Recruitment materials including a study flyer and information about the risks and benefits associated with the study, were distributed by email,

newsletters, workshops, and a Facebook page. Those interested were able to voluntarily participate by following a link from the flyer to an online survey to collect informed written consent and demographic data.

### *5.6.3 Data collection*

Data was collected using semi-structured interviews, which allowed for guided exploration of participant experiences within the allocated timeframe recognising that educators and cooks are time poor. As it has been previously reported that there are workforce challenges, staff shortages and poor work conditions (35). In-person interviews were chosen to minimise participant burden, as educators and cooks often face administrative demands outside of work hours and may lack access to a private computer space at work. Conducting individual interviews face-to-face allowed for confidential discussion of workplace relationships and barriers at a time and location convenient to participants. Face-to-face interviews also allows for observation and richer discussion of contextual factors. The interview guide (Supplementary file 1) contained seven open-ended questions and additional prompts based on the Consolidated Framework of Implementation Research (CFIR). The CFIR describes factors influencing implementation across five domains: Innovation, Outer Setting, Inner Setting, Individuals and Implementation Process (36). The interview focused on exploring participant experiences of implementing the *Innovation* or healthy eating policies and programs, and how implementation is influenced by *Inner Setting* organisational factors and *Outer Setting* factors that capture the community, political, and economic environment. The interview guide was piloted with an educator and cook not included in this sample to ensure clarity and relevance of the questions. Following pilot testing, the interview guide was revised to better define and clarify the term "resources", emphasising that this included not only equipment but also staffing and budget. A prompting question was also added to explore whether there were additional resources participants would like to have. The number of educators and cooks interviewed was guided by the information power principle whereby, the depth and richness of data was achieved among a targeted sample (37, 38). Participants were recruited with support from health promotion services, resulting in a homogenous sample of cooks and educators who were more involved in nutrition and healthy eating,

thus offering insights relevant to the study aims. The study had a specific aim and was informed by the established CFIR framework. Based on these factors, the sample size of 12 participants was deemed to provide sufficient information power to address the study aims.

Participants were interviewed at the ECEC service where they were employed by the first author (JC). Verbal consent was obtained prior to collecting audio-recording of the interviews using Zoom software. Audio-recordings were transcribed verbatim using Microsoft Word. Participants received an AUD $30 gift voucher following the interviews to reimburse them for their time. Ten interviews with four educators and six cooks were conducted between December 2023 and April 2024. Interviews ranged from 18 to 70 minutes, with a mean of 36 minutes.

### *5.6.4 Data analysis*

Reflexive thematic analysis was selected because it is suited to our theoretical orientation, valuing meaning produced from participants subjective experiences and researchers perspectives and assumptions (39). The theoretical flexibility of reflexive thematic analysis also allowed for authors to bring in constructs from the CFIR to provide a lens to code and understand patterns of meaning (40). Data were analysed by the first author (JC) using Braun and Clarke's six-phase approach (41). The process involved JC reading the transcripts repeatedly to familiarise and engage with the data. Transcripts were first inductively open coded followed by a second round of coding bringing in the CFIR to articulate specific constructs and generate initial themes. JC continued to review and refine the themes until clear central organising concepts were identified, ensuring a fit with the data set. To ensure research quality, each stage of the analytic process was documented and JC reflected on the values and perspectives as a dietitian and researcher throughout the process. Data were managed using Nvivo 14.

## 5.7 Results

Participant and centre characteristics are presented in Table 5.1.

**Table 5.1.** Demographic characteristics of participating educators ($n$ = 4) and cooks ($n$ = 6) and centre characteristics ($n$ = 10).

| Participant characteristics | n (%) |
|---|---|
| **Gender** | |
| Female | 9 (90.0) |
| Male | 1 (10.0) |
| **Age** | |
| 30-39 years | 4 (40.0) |
| 40-49 years | 4 (40.0) |
| 50-59 years | 1 (10.0) |
| 60-69 years | 1 (10.0) |
| **Education level** | |
| Secondary Education | 1 (10.0) |
| Certificate I-IV | 3 (30.0) |
| Graduate or Advanced Diploma | 3 (30.0) |
| Degree (Bachelor, Masters, Doctorate) | 3 (30.0) |
| **Country of birth** | |
| Australia | 2 (20.0) |
| Other † | 8 (80.0) |
| **Centre characteristics** | **n (%)** |
| **Number of children enrolled** | |
| Range (n) | 30 – 102 |
| Average (n) | 63 |
| **Service provider type** | |
| For-profit | 2 (20.0) |
| Non-profit | 8 (80.0) |
| **Food preparation** | |
| All meals cooked on-site | 10 (100.0) |
| **Socio-Economic Status (SEIFA 2021)** ‡ | |
| Most disadvantaged (quintiles 1-3) | 0 (0.0) |
| Most advantaged (quintiles 4-5) | 10 (100.0) |

† Argentina, Brazil, India, Indonesia, Netherlands, Northern Ireland, Taiwan, United States of America

‡ Socio-Economic Indexes for Areas (SEIFA) IRSAD Quintiles: Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) provides a measure of advantage and disadvantage based on economic and social conditions, such as income and occupation, of people and households within a geographical area. A high score indicates a relative lack of disadvantage and greater advantage. Most disadvantaged = quintiles 1-3. Most advantaged = quintiles 4-5.

### *5.7.1 Theme 1: Inner setting factors fostering local champions*

*Inner setting factors fostering local champions* captures participants reflections of the factors driving implementation of healthy eating practices. Participants articulated reliance on personal motivations, interests and experiences to fulfil their roles around food and nutrition. Outside of their individual attributes, participants described supportive relationships in the inner setting, which contributed to their ability to act with agency and feel empowered in their roles.

*You only limit yourself*

While acknowledging challenges, both educators and cooks described being confident in their competence, knowledge, and skills required to fulfil their role and implement healthy eating practices. This was evident in the way participants described opportunities to innovate. For example, one educator commented "we are not hesitant to try something different" (participant 27). Participants situated their experience as different from others suggesting this is not the case across the sector.

> "I'm special. I'm different, you know. I can do it. I can do a very good meal in one hour, but that's me, [other cooks] they can't." (Participant 32, cook, responsible for menu planning)

> "I think if you probably talk to other chefs there would be a lot more barriers. Just because this comes like second nature to me." (Participant 18, chef)

Some participants attributed their capability to their years of experience in the industry and previous roles in commercial kitchens which equipped them with practical knowledge and skills to adapt in the ECEC setting. Participants also described their own motivation to challenge themselves, articulating a commitment to continuous improvement and learning. One cook commented "I think you only limit yourself" (Participant 20).

> "I love to do lots of research and I like to learn new things. And yeah, I do a lot of it on my own" (Participant 11, cook, responsible for menu planning)

Additionally, participants described a sense of personal fulfilment in their roles, especially in fostering children's healthy eating habits and supporting families to manage fussy eating. One chef commented

that the sense of fulfilment from educating and exposing children to new foods was very important, otherwise "it becomes just a job, and you just become a robot […] it's very satisfying to see [the food] not coming back" (Participant 40, chef). Participants highlighted the importance of connecting with children and families and helping families who might not have the knowledge around nutrition and healthy eating. When asked about incentives, participants frequently described seeing changes in children's eating habits as a key motivating factor to continue to implement healthy eating practices.

> "I'm here because I would like to make a difference in children's lives […] And it's also building the relationships with the kids and the parents. [My reward] doesn't come from the company." (Participant 50, cook, responsible for menu planning)

*You are a role model for the job*

Educators frequently described their own personal interest in healthy eating and nutrition as a facilitator to advocate for and implement healthy eating policies and practices. For instance, centres relied on educators whose passion or "area of expertise" was food and nutrition to plan and run cooking experiences with the children. One participant highlighted the importance of training opportunities in reinforcing staff interest to implement healthy eating practices and share this knowledge with other staff.

> "I attended a lot of [Munch & Move] training […] it confirms my own personal value and philosophy that "Oh yes, this is very important, this is what we need to do with the children." (Participant 44, educator)

Educators also discussed being "a role model for the job" and reflected on their own personal eating habits influencing delivery of healthy eating practices. For example, one educator commented that being a "healthy eater" allowed them to better role model healthy eating habits during mealtimes. Participants reflected that their personal experiences provided credibility when supporting families. One participant likened the situation to being a personal trainer, commenting if the personal trainer was not physically active themselves, they would not have any customers. Another participant reflected that her own personal experience as a mother of five was a "selling point to families"

(Participant 52, educator). Participants noted unhealthy habits in educators around them and attributed this to educators being "mentally really exhausted when [they are] working with the children the whole day" (Participant 17, educator).

*Supportive leadership*

In addition to their own capability, motivation and interest, participants described supportive relationships and high-quality communication within their organisation to facilitate implementation of healthy eating policies and practices. Participants emphasised the importance of trust from directors and autonomy to be creative as facilitators to fulfilling their roles. For example, Participant 18 highlighted the support of her director, who provided an iPad that enabled access to recipes and enhanced communication with parents through sharing photos of food at pick-up.

> "I have a great director, that literally lets me be creative and do what I need. I have access to my own […] iPad in the kitchen. So yeah, I can always look up new inventive things, I've got the teacher support. We've got a lot of parents' support." (Participant 18, chef)

Two participants also identified flexibility around budget from centre directors as an important facilitator. Participant 27 reflected that in their previous role as an educator at a private for-profit centre, "everything is money minded" which restricted the healthy eating learning experiences they were able to provide to children. In comparison, in their current role at a not-for-profit centre, there is flexibility around the budget providing greater freedom to plan and order food supplies for cooking experiences with children.

> "[The director] always told me that there's no [limit to the] budget for food we can buy. So, I like the freedom in everything I get here and that has boost up my confidence as well." (Participant 27, educator)

Furthermore, centre routines around mealtimes and programming time, was described as pivotal for creating a supportive environment for participants to deliver healthy eating practices.

### *5.7.2 Theme 2: Outer setting sector challenges*

While participants articulated feeling capable and motivated to deliver healthy eating practices, implementation was contingent on factors outside of their control. *Outer setting sector challenges* captures the tensions articulated by participants between commitment to implement healthy eating policies and practices under ideal conditions and complexities in their daily reality. Participants reflected on goals to improve implementation of healthy eating practices but described uncertainty around when goals could be achieved. Implementation was dependent on the right conditions and when opportunities aligned. Participants described staff shortages, being too busy and not having enough time to plan fun ways of engaging children, lack of ideas and prepared resources, and waiting to "get back into routine" (Participant 17 & 20). This idea is articulated by participant 11 who described implementing cooking activities with children "in the beginning of the year when things were a little bit better".

*Out of our control*

Implementation of healthy eating practices relied on certain individuals with interest or expertise to improve or implement, rather than a collaborative effort. There was a tension in beliefs around what educators, cooks, and families should be doing and whose responsibility it was to engage children. Some educators felt that the cooks should improve the menu such as including more variety of foods to encourage children to eat. On the other hand, cooks described their role as limited to providing food and educators to motivate children to eat. Some cooks articulated that it should be the responsibility of an external expert to ensure that the menu meets nutritional requirements.

> "I don't know how the educators they feed the kids, but for me it's their job to motivate the kid to eat it" (Participant 32, cook, responsible for menu planning)

Participants commented on the importance of collaboration to support implementation of healthy eating practices. For instance, collaboration between educators to plan cooking experiences and cooks to organise materials to support with delivery. However, participants articulated that the lack of

communication and support from other staff was a limitation to supporting children's healthy eating behaviours.

> "If you don't have a strong enough team, it's hard to be consistent and to try to teach them these things." (Participant 50, cook, responsible for menu planning)

> "I think another barrier is the people you work with, if we all have the same mindset about healthy eating, we could come up with a project together to do with the children." (Participant 17, educator)

*Outer setting partnerships*

Participants described partnership and trust from parents as a crucial factor. One educator noted that "the collaboration with the family is the biggest thing and maybe the only one externally" (Participant 44).

> "To succeed in here as a cook and making sure that you can provide healthy eating [you need to] try to build that close professional, you know, relationship with the families" (Participant 11, cook, responsible for menu planning)

Participants described reaching out to government health service support, *Munch & Move*, for free training to support them to deliver healthy eating policies and practices. This included working with *Munch & Move* to manage and support families with fussy eating, menu planning and training. However, beyond partnerships with families and *Munch & Move*, educators and cooks reflected that there were limited opportunities for partnerships outside of the ECEC setting, particularly with local community members such as local grocers and chefs that could provide learning experiences for children. Cooks reflected that they felt alone in their role, due to a lack of opportunities to network and communicate with other cooks in the sector. When asked about partnerships and networks, participants reflected there were no active support networks and relied on looking for their own peer networks, such as through Facebook group, to connect with other ECEC cooks.

> "The only people that I work with is Munch and Move. Cooks in centres, they should be supported a little bit more but sadly […] it's just once you're once you're in, it's up to you to make that leg work." (Participant 11, cook, responsible for menu planning)

Cooks also frequently emphasised the importance of having partnerships with local grocers and butchers for a reliable food supply. Cooks commented that access to multiple local suppliers ensured reliable delivery of ingredients that enabled them to provide healthy meals in line with the planned menu. Cooks highlighted that their ability to provide healthy foods on the menu was influenced by the time available. Partnerships with sector-specific suppliers that offer pre-cut meats in child-appropriate sizes and commercial-sized cans helped maximise efficiency and support the provision of healthy meals.

*Inadequate industry support*

Cooks articulated that they did not feel as though their challenges were understood by management at higher organisational levels or by the ECEC sector. Cooks described instances where senior management failed to consider the practicalities of food preparation in the ECEC setting, leading to conflicting priorities and increased pressure. Some attributed this to poor communication and lack of opportunities to voice their perspectives to management.

> "Look, I feel like management does a lot of talking. I feel like it should be a bit more about how we do things, how the kitchens run, like what our menus are, what our struggles are, you know, like try to keep on budget, where can we get the better option?" (Participant 18, chef)

Participants also perceived that the NSW Health *Caring for Children* guidelines were not practical for the demands of their role. Participants felt that the *Caring for Children* guidelines did not consider available resources including time and space, food allergies, children's taste preferences, and fussy eaters, and felt guidelines were too restrictive or boring. Participant 20 highlighted that the recommendations for red meat meals were not realistic in practice, noting that children often refused to eat the meat when it was provided.

> “I wish a nutritionist could see that at lunch. Those kids won't eat that. And as much as we're encouraging it, you know, they could give us tips.” (Participant 20, cook, responsible for menu planning)

Participants described being thrown in at the deep end when starting their role and expected to support healthy eating without adequate support and guidance, given the lack of nutrition education receiving during their training. Participant 11 likened their experience to being “thrown into the middle of the ocean. You must swim. You might drown. Good luck to you.” Some cooks expressed concern about the quality of new educators, noting the lack of experience, confidence, and knowledge.

> “But because we haven't got the staff and a lot of the girls are not that confident. It's not really. It's not happening as it should be happening. Yeah, that's the sad truth, actually.” (Participant 11, cook, responsible for menu planning)

Participants commented that there was inadequate support and guidance from providers. Beyond that they were also limited opportunities for training to upskill themselves within the workplace setting, particularly for cooks compared to educators. Participants often relied on upskilling themselves by paying for their own courses and doing their own research through the internet. Others used their peer networks, such as Facebook groups for cooks, to look for healthy menu ideas from other services.

> “But also, to the fact that when I entered the company, I had no support to start with. They had nothing to offer in terms of the network, in terms of previous menus. All they said is here's your password, you need to order from Coles. Here is your budget $800, go for it.” (Participant 50, cook, responsible for menu planning)

Participant 32 compared ECEC with the aged care sector to highlight the lack of training and professional development opportunities in the ECEC sector.

> “Well, I think when I was in aged care, just comparing environments. We had lots of training like we had courses like we had to do refresh courses every six months and all this. Was it a little bit overwhelming, yes. But like now in childcare, there's none.” (Participant 32, cook, responsible for menu planning)

While some participants felt fulfilled supporting healthy eating and motivated to do their own research as explored in Theme 1, for other participants, competing demands and the lack of support meant that professional development around healthy eating was not prioritised in planning and practice. Furthermore, participants described not knowing where to go to access information and professional development opportunities, again relying on their own research, highlighting the lack of sector support.

> "[…] if I could get it, I would. I've never thought about it and how to even go about it. I should probably go and google it." (Participant 52, educator)

Participants articulated unrealistic expectations from centres/providers to complete administrative, planning, and quality improvement tasks on top of their primary responsibilities. Participants described doing their own research in their own time, which was not recognised by the centre. Participant 50 described feeling undervalued and commented on the need for more compensation for their responsibilities.

> "They should either one, if they don't want to pay cooks to do menus they create menu, get somebody to create menus for them and then just distribute it them quarterly […] Or pay the cooks quarterly. If educators are getting paid to plan activities for children […] it just seems logical that of course the cook needs time to plan a menu." (Participant 50, cook, responsible for menu planning)

*Inconsistent practices*

Participants expressed frustrations at the inconsistencies in practices between the home and ECEC setting and between ECEC services. Participants perceived that unhealthy home environments and practices contributed to fussy eating and undermined the practices promoted at ECEC. Participants attributed this to lack of support for families such as inadequate nutrition education and financial resources for some.

> "And then it also needs to be backed up with the support at home. What I find is a lot of families are they pick the kids up and they have chocolates in the car for them, which is

> [against] everything we're teaching them to eat healthy […] you have to have the support all the way through or it just doesn't work, or everything you've done up until they get to the age of three starts to fall apart." (Participant 50, cook, responsible for menu planning)

Educators expressed that they can only guide families and that ultimately, it's up to children and families' choices. Some articulated that implementing supportive feeding practices, such as role modelling and encouraging children to try new foods, was not a primary focus of their role, as they felt their capacity to influence children's eating was limited. While they could prompt or encourage, it was up to children to decide what and how much to eat, which was perceived as beyond their control. When educators noticed that children were not eating at the centre, they were happy to support families and provide guidance on strategies that could be used home to manage fussy eating when asked by families. However, educators expressed they did not feel comfortable initiating the conversation as they didn't want to appear to question their parenting and offend families. When asked whether they required additional support for communicating with families, educators expressed that this was beyond their control what parents decide to feed their children at home.

> "So I think parents have the prime most responsibility. We can guide them, we can tell them. But at the end of the day, it's their children, their choice." (Participant 27, educator)

Cooks noted differences in guidelines between jurisdictions within Australia, noting New South Wales guidelines felt more restrictive compared to Queensland. Participants also described differences in healthy eating policies and practices between private for profit and non-profit service types. These descriptions were inconsistent with some describing for profit/private centres were more restrictive with food budgets and focused on profit maximisation while other constructions were more positive, describing more resources and support for healthy eating. Inconsistencies were described in how food was served, how they prioritised healthy eating, and how staff were treated. Participants expressed frustrations at the inconsistencies and commented on the need for further support.

> "I've been in many centres and every centre is different […] So in my opinion, if we have something standard by the government would be good." (Participant 35, cook)

## 5.8 Discussion

This study highlighted the importance of addressing contextual factors to support the implementation of healthy eating policies and practices in the ECEC sector. We used the CFIR to guide data collection and identification of *Inner setting* organisational factors and *Outer setting* factors encompassing the broader sociocultural, economic, environmental, and political conditions. Our study revealed that there was commitment from ECEC staff, support from directors, and healthy eating support provided by local health services. However, current ECEC sector conditions were not conducive to successful implementation of healthy eating policies and practices. Implementation was limited by inadequate work infrastructure to support collaboration between management, cooks, educators, and families, lacking partnerships with external organisations, and insufficient opportunities for nutrition training and education.

Findings from this study suggest that educators viewed themselves as role models in shaping children's diets. However, participants suggested this was not the case across the sector and there were differing views on the extent of their roles and responsibilities regarding healthy eating. Without adequate work infrastructure to define roles and responsibilities and foster collaboration between management, educators, cooks, and families, implementation of healthy eating practices was dependent on individuals who have the capability, motivation, interest and personal experience. This is consistent with previous literature highlighting that personal beliefs and experience influenced educator attitudes and confidence and guided their approach to feeding within their professional role (42). Additionally, findings from this study suggest implementation leaders may be constrained by other staff who did not share the same values and beliefs. Research shows that ECEC staff were more fulfilled when there was shared values and vision which allowed for great job control and low levels of emotional exhaustion (43). Furthermore, parent support and partnership were identified as important enablers, but participants expressed frustration at inconsistencies between home and ECEC settings. Perceived inconsistencies in parent engagement or systems-level support can undermine educators' perception of their ability to implement healthy eating practices (44). While previous literature has primarily focused on educators, our findings suggest that similar challenges are also

experienced by cooks. When other ECEC staff practices or parental preferences are not aligned with best-practice guidelines or service policies, this can create confusion about how to best meet children's needs and weaken the shared commitment and partnership, or collective agency, between ECEC staff and parents that is essential for implementing and sustaining healthy eating practices in ECEC (44). These findings suggest that implementation support is needed to engage educators, cooks, providers and families and strengthen collaborative efforts to implement healthy eating policy and practice. Staff communication, collaboration and well-established internal social networks has been identified as a facilitator to healthy food provision (21). Further research to explore how to improve work infrastructure and organisational practices with centre management is recommended.

This study identified insufficient nutrition education and training, and participants mostly relied on their own research. Additionally, there was a lack of industry support, particularly for staff new to the industry. Findings emphasised the need for better orientation practices within organisations and ongoing access to free training. Consistent with previous literature, the findings from this study also highlight a lack of support for cooks and chefs within the industry, limiting capacity to respond to complexities within their roles such as navigating food allergies and family preferences (24). Providing ongoing training such as through an e-learning course can provide continual opportunities for professional development on a large scale in the ECEC setting (45). Further research to investigate training and support strategies for ECEC staff to identify the most effective approaches for promoting healthy eating in early childhood settings is recommended.

Inconsistencies in implementation of healthy eating policies and practices within and between centres were identified as a barrier to implementation. This may be due to varying interpretations of the National Quality Standards (NQS) (46). While the NQS emphasises the importance of promoting healthy eating, it lacks guidance on effective implementation. Additionally, the current assessment and rating process does not require observation of food provision, mealtime practices, or related learning experiences. As a result, there may be discrepancies between policy and practice. Notably, when asked about current healthy eating policies and practices, participants did not refer to centre nutrition policies. An assessment of written nutrition policies in the ECEC setting showed that many lacked

clarity and comprehensiveness needed to guide practice (47). Strengthening the National Quality Standards and guidelines to operationalise the standards, may improve awareness and understanding of educators' and cooks' role around healthy eating and support implementation of nutrition guidelines. Additionally, strengthening the assessment and rating process is recommended to ensure that centre menus and policies provide clear and comprehensive guidance on food provision and mealtime environments and that practice aligns with policy. However, growing job demands without adequate support and pay has been associated with high levels of burnout and stress, decreased wellbeing and increased staff turnover in the ECEC setting (35). Sector-wide policies, including the implementation of professional development initiatives, are necessary for enhancing ECEC work environments and supporting staff in delivering high-quality education and care (48). Furthermore, differences in available resources and practices between profit and non-profit centres may result in discrepancies in implementation across New South Wales (49). Partnership with government health services for implementation support and further research on how guidelines are conceptualised and interpreted may address this incongruence.

Our study used purposeful sampling to capture a wide range of experiences, but participants were all located in advantaged areas. Additionally, the sample was determined by those who were interested and voluntarily elected to participate in the study. As such, the sample may over-represent educators and cooks who were personally motivated and confident to deliver healthy eating practices. Given widely reported challenges with staff shortages, burnout and stress, the included sample may not be representative of those who did not have time or capacity to participate. The experiences educators and cooks were included to ensure both intervention end-users were represented and strengthen understanding of contextual factors at the organisational and systems-level. However, combining the two groups in analysis may risk diluting the nuanced perspectives unique to each role, which could limit the ability to identify role-specific challenges and develop tailored support strategies. While the sample may limit transferability of findings to all long day care services, they represent important experiences from the many children and families they collectively and cumulatively engage. Further research is warranted to explore the contextual factors of educators and cooks located in

disadvantaged areas by focussing sampling areas to select ECEC services located in most disadvantaged areas based on the Index of Relative Socio-economic Advantage and Disadvantage. Additionally, capturing experiences of educators and cooks from other service types such as lunch box services where families provide meals, is warranted as these services are most common in disadvantaged communities (50). This will inform healthy eating policy and practice that reflects the diverse contexts and experiences within the ECEC setting.

## 5.9 Conclusion

The ECEC setting can provide a critical opportunity to reach children and families to promote healthy eating behaviours at an early age. However, systemic changes are needed to support implementation of healthy eating policies and practices. Supporting educators and cooks through provision of opportunities for professional development, partnerships and connections across the industry is recommended. This may enable a change in work culture from one that is reliant on individuals and personal motivation, to one that fosters a systematic approach involving all staff. Implementation is dependent on consistency in practices between the home and ECEC settings. Greater support for families is needed to ensure implementation of healthy eating policies and practices are translated into improved dietary outcomes in children.

## 5.10 Conclusion to chapter

The qualitative study with educators and cooks enhances the understanding of contextual factors influencing implementation of healthy eating policies and practices in the ECEC setting. In addition to the findings presented in **Chapter Four**, this chapter informs recommendations for policy and practices to address environment and policy level determinants and enhance implementation of healthy eating interventions in the setting. **Chapter Six** will summarise and integrate the findings from the scoping review and qualitative studies, their implications, and recommend actions needed to improve children's diets using a systems-based approach.

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## 5.12 Supplementary material

**Supplementary file 1: Semi-structured interview guide**

**Note**: Prompts have been provided to help guide the interview and probe for more information if needed, however, **not all prompts will be asked**.

**Introduction:**

- Thank you for participating in this interview. Introduce interviewer and their role.
- In this interview, I want to ask about your expert experience and knowledge as a director/educator/cook and understand what has helped or hindered your service to deliver and continue to provide healthy eating activities.
- The interview will take about 30-40 minutes and will be audio recorded. Your answers will then be written as notes and sent back to you for comment and/or correction. The recordings and written notes will be stored securely and used only for the purpose of this study.
- All information you provide will be confidential and you will not be identified by name in any report.
- Participation in this interview is voluntary. You are not required to answer any questions that make you feel uncomfortable. You are free to withdraw from participation at any stage.
- By participating, you are telling us you understand what you have read in the participant information sheet and consent to take part in an interview and for this information to be used in this study.
- Please ask questions about anything you don't understand or want to know more about. Do you have any questions before we begin?

To begin with, could you please briefly tell me about your role in the service?

- What is your role around food (e.g. preparation, food service, menu planning)?
- How many years of experience do you have working in early childhood education and care?

Thank you. I will now move on to some questions that will help us understand what helps or hinders your service to provide healthy eating.

| CFIR Domain | Objectives | Interview questions: Educators | Interview questions: Cooks |
|---|---|---|---|
| **Context** | To identify interventions currently being implemented | 1. Can you tell me about any rules/guidelines, activities or projects at your service that support children and families with healthy eating?<br>• What do you like about it?<br>• What do you dislike? | 1. Can you tell me about any rules/guidelines, activities or projects at your service that support you to provide healthy food?<br>a. What do you like about it?<br>b. What do you dislike? |
| **Innovation** | To identify the components of the innovation that enable and/or inhibit implementation and sustainment of nutrition interventions. | 2. What features would you need to continue, improve, or discontinue the rules, activities or projects?<br>*Prompts:*<br>- What would you change and why? What would you keep and why? | 2. What features would you need to continue, improve, or discontinue the rules, activities or projects?<br>*Prompts:*<br>- What would you change and why? What would you keep and why? |
| **Inner setting** | To identify the inner setting organisational barriers and enablers to implementation and sustainment of | 3. How does supporting children and families with healthy eating fit within your priorities as an educator?<br>*Prompts;*<br>- What are the values/beliefs around healthy eating? | 3. How does providing healthy food fit within your priorities as a cook?<br>*Prompts;*<br>- What are the values/beliefs around healthy foods?<br>4. Tell me about the resources available in your service to provide healthy food. |

| | | | |
|---|---|---|---|
| | nutrition interventions. | 4. Tell me about the resources available in your service to support children and families with healthy eating.<br>*Prompts:*<br>- How does the space/layout and equipment at your service influence how you support healthy eating?<br>- How does management or leadership support influence how you support healthy eating?<br>- What are the incentives or rewards for supporting healthy eating at your service.<br>- Tell me about any guidance or training you get for supporting healthy eating.<br>5. What resources do you need to continue supporting healthy eating? | *Prompts:*<br>- How does space and equipment for cooking change how you provide healthy food?<br>- How does cost/budget change how you provide healthy food?<br>- How does management or leadership support change how you provide healthy foods?<br>- What are the incentives or rewards for providing healthy food at your service.<br>- Tell me about any guidance or training you get for providing healthy food.<br>5. What resources do you need to continue providing healthy eating? |
| **Outer setting** | To identify the outer setting barriers and enablers to implementation and sustainment of nutrition interventions. | 6. Tell me about the things outside the control of your service that effect how you support children and families with healthy eating?<br>*Prompts:*<br>- How has the way you support healthy eating been affected by big events (e.g. COVID-19)?<br>- How has the way you support healthy eating been changed by community values/beliefs?<br>- How has the way you support healthy eating been changed by community/ external resources (e.g. healthy eating apps/programs)?<br>- How has the way you support healthy eating been changed by external entities (e.g. professional networks, community partners).<br>7. What external support do you have/would you need to continue to support children and families? | 6. Tell me about the things outside the control of your service that effect how you provide healthy food?<br>*Prompts:*<br>- How has the way you provide healthy food been changed by big events (e.g. COVID-19).<br>- How has the way you provide healthy food been changed by healthy eating policies and guidelines?<br>- How has the way you provide healthy food been changed by community values/beliefs?<br>- How has the way you provide healthy food been changed by community/ external resources (e.g. menu planning apps/ programs)<br>- How do you order and shop for healthy foods?<br>7. What external support do you have/would you need to continue providing healthy food? |

**Close of the interview:**

Is there anything else you would like to add?

If you experience any discomfort or distress from the interview, please refer to the Participant Information Sheet for support services that you can contact.

Thank you for participating in this interview today, we really value your insight and appreciate your time. I will email you a summary of the results of this study once they are ready if you have requested this in your consent form.

# Chapter Six: Recommendations for research, policy and practice

## 6.1 Thesis aims

The objective of this research was to investigate how we can improve the translation of early childhood nutrition interventions into real world outcomes. To address this complex public health challenge, a systems-based approach was used to explore how individual, interpersonal, and broader economic, social, physical and political determinants shape children's diets. This thesis contributes to the accumulated knowledge by mapping and synthesising nutrition interventions targeting early childhood (children aged 2-5 years) to identify leverage points for strengthening actions. A scoping review was used to quantify system determinants most frequently addressed by interventions and those priority areas overlooked and understand the impact on children's diets. The environment and policy-level determinants in the Early Childhood Education and Care (ECEC) setting were identified as key leverage points for promoting healthy eating. Qualitative methods were used to explore the contextual factors influencing policy and practice implementation from the perspectives of early childhood directors, educators, and cooks. This informed recommendations for enhancing the success of nutrition interventions implemented in the ECEC setting to improve children's diets.

## 6.2 Key findings

1) Aim One: To map early childhood nutrition interventions and quantify food system determinants most frequently addressed and those overlooked

There is a large body of evidence exploring the impact of nutrition interventions on dietary outcomes of pre-school aged children. However, the most effective ways to translate improvements achieved in children's diets at the population-level remains unclear. **Chapter Two** presented the first scoping review, which systematically mapped early childhood nutrition interventions to identify leverage points within the food system using the comprehensive Determinants of Nutrition and Eating (DONE) framework. The review identified that interventions predominantly focused on individual and interpersonal level determinants. The most frequently addressed determinants were related to improving parental nutrition knowledge and parent behaviour at the interpersonal level and children's

nutrition knowledge and skills at the individual level. Significant gaps in addressing environmental and policy-level determinants were identified in the review. Home food availability and accessibility at the environmental level was identified as an important but understudied determinant that should be prioritised to improve children's diets. Additionally, more evidence is needed to address children's food environments particularly the ECEC setting and broader food environment through industry and government regulation. A systems approach addressing these gaps is necessary to ensure cohesive action across the food system and improve success of interventions in the ECEC setting. For example, implementation of multilevel interventions that include both ECEC and home food environment components to improve children's diets.

2) Aim Two: To synthesise evidence on the impact of early childhood nutrition interventions on children's diets and identify determinants for strengthening action

In **Chapter Three**, the scoping review synthesised the evidence on children's dietary intake outcomes mapped to food system determinants addressed by early childhood nutrition interventions. The review identified that interventions that target determinants related to children's nutrition knowledge and sensory perception at the individual level were effective at improving children's dietary intake. However, these findings should be interpreted with caution as no formal assessment of study quality was undertaken. There is evidence to suggest that studies supporting nutrition education interventions are of low quality (1). Studies show that preschool aged children are unable to comprehend the effect of healthy foods on health outcomes and cannot use nutrition knowledge to make informed food choices (2). Preschool aged children's eating behaviours are influenced by parent and caregiver feeding practices and diets are determined by what and how much food is offered to children by parents and caregivers (3, 4). As such, targeting caregivers such as parents and ECEC educators and cooks may be more appropriate strategies for influencing children's diets.

The evidence for the impact of interventions targeting parental nutrition knowledge on children's diets was mixed, despite an abundance of studies addressing this determinant. Further research to identify effective strategies involving parents is warranted, given that parents are primary stakeholders responsible for the majority of food provision and feeding. Within the home food environment,

healthy food subsidies showed improvements in fruit and vegetable intake, but the evidence was mixed. Further research is recommended to identify more effective strategies to reduce the consumption of EDNP foods and SSB in the home setting, given the importance of home food availability and accessibility identified in **Chapter Two**. Within the broader food environment, manipulating the nutritional composition of meals and snacks provided to children had a positive impact on fruit and vegetable intake. This determinant should be leveraged in the ECEC setting such as through menu policy guidelines. Moreover, interventions addressing the ECEC food environment can improve children's diets, but the evidence was inconsistent. A key finding identified was the paucity of policy-level interventions to embed healthy eating into routine practice in ECEC setting, despite most studies being conducted in this setting. Nationally co-ordinated government initiatives, such as healthy food subsidies, and food marketing and labelling laws, resulted in a positive impact on children's diets. However, the implementation of these interventions is currently limited to the US and Chile. Further research to translate these initiatives in other countries is recommended given the potential of these interventions. Findings from the scoping review demonstrate the potential impact of environmental and policy-level action to improve children's diets and further highlights the need to strengthen action in these areas.

As identified in the scoping review presented in **Chapter Three**, the ECEC setting provides a powerful opportunity to reach children and families, promote healthy eating habits, and improve children's diets. While this setting is well-studied, the evidence for impact on children's diets is mixed and there is limited policy-level action to support implementation of healthy eating interventions into routine practice. An understanding of contextual factors can aid the development of broader policy-level action to improve the success of healthy eating interventions in the ECEC setting. To explore the contextual factors in the ECEC setting, two qualitative studies were conducted with directors (**Chapter Four**), educators and cooks (**Chapter Five**). The qualitative approach used in these studies allow for in-depth discussion and acknowledges the varying experiences of participants, providing a better understanding of the contextual factors influencing implementation (5).

3) Aim Three: To explore contextual factors influencing Australian ECEC directors' decisions to implement healthy eating policies and practices in the ECEC setting

Semi-structured interviews were conducted with twelve directors from centre-based ECEC services to understand the contextual factors influencing implementation of healthy eating policies and practices (**Chapter Four)**. Thematic analysis revealed that aligning healthy eating policies and practices with centre values and goals, such as curriculum requirements, was a facilitating factor. This allowed directors to leverage existing work infrastructure and navigate challenges associated with competing demands for limited resources within services. There was a mixed response from directors regarding staffing levels. Some directors relied on motivated and passionate staff, while others noted broader funding and workforce conditions leading to high staff attrition inhibiting continued implementation of healthy eating policies and practices. External partnerships with Local Health District Health Promotion Services as part of the *Munch & Move* initiative supported directors with menu planning and healthy eating resources. However, directors emphasised a lack of engagement with external networks beyond their partnerships with local health promotion services. ECEC directors articulated that external pressure and unrealistic expectations from guidelines and parents were barriers for implementing healthy eating policies and practices. For instance, directors felt that guideline requirements for red meat and vegetables did not align with their priorities around managing food allergies, fussy eating and reducing food waste. Furthermore, directors highlighted inconsistent healthy eating practices at home as a factor inhibiting the success of the implementation of healthy eating practices in the ECEC setting. Directors recommended multisectoral partnerships between regulatory bodies, local government councils, and health services to support implementation given the competing priorities and availability of resources. ECEC directors also advocated for investments in the workforce to reduce staff attrition and foster local champions to lead implementation. While healthy eating policies and practices aligned with internal goals and values, there were many competing priorities within the ECEC setting inhibiting implementation. Findings from the study highlight the need for supportive partnerships and work conditions to increase implementation of healthy eating policies and improve children's diets.

4) Aim Four: To explore contextual factors influencing the implementation of healthy eating policies and practices from the perspectives of Australian early childhood educators and cooks

**Chapter Five** described the experiences of early childhood educators and cooks who play pivotal roles in the delivery of healthy eating policies and practices. Most participants were confident and committed to implementing healthy eating policies and practices. However, not all educators and cooks shared the same goals and values around healthy eating. The implementation of healthy eating practices was dependent on educators and cooks personal motivation and experience. Trust from directors, along with the autonomy to implement healthy eating policies and practices, was identified as important enabling factors. Differences in the perspective regarding roles and responsibilities for implementing healthy eating policies and practices were observed among participants. There were also inconsistencies between the home and ECEC environment which inhibited the success of implementation. Additionally, educators and cooks described inadequate sector support for delivery of healthy eating practices. There were insufficient opportunities for nutrition professional development and networking across the sector. Beyond partnerships with *Munch & Move*, parent and community networks were identified as important but lacking.

Findings from this study highlight the need to address outer setting, systems-level factors to enhance implementation of healthy eating policies and practices. Key recommendations include the provision of professional development initiatives to build workforce capability for delivering healthy eating policies and practices. This involves better training and orientation practices before entering the workforce as well as opportunities for ongoing professional development. Stronger work infrastructure such as internal networking opportunities and organisation of tasks and responsibilities related to healthy eating through centre nutrition policy may be necessary to foster collaboration between educators and cooks to implement healthy eating practices. Programs to support families are also recommended to enable consistent implementation of healthy eating practices across the home and ECEC setting. Further research is warranted to understand the contextual factors between for-profit and not-for-profit service types to inform tailored support. It is acknowledged that the sample of educators and cooks who volunteered to participate in the study were confident in their capabilities to

implement healthy eating practices and were all located in advantaged areas. Additional research with educators and cooks from ECEC services located in disadvantaged, rural and regional areas may improve transferability of the evidence and provide a better understanding of the wide range of contextual factors that need to be addressed.

## 6.3 Implications of findings for future research, policy and practice

### *6.3.1 Overall implications of the research findings*

5) Aim Five: To integrate the evidence from Aims One to Four and make recommendations for strengthening action to improve the diets of children aged 2 to 5 years

This thesis highlighted the need for policy-level action within the ECEC setting and identified leverage points to improve implementation and translation of nutrition interventions into real-world outcomes on children's diets. The World Health Organization (WHO) has developed a toolkit to guide best practice standards related to healthy eating, physical activity, and safe sleep in ECEC settings. The toolkit recommends countries should demonstrate strong leadership, allocate adequate resourcing and financing, provide opportunities for multisectoral partnerships, build workforce capability, and use evidence to shape policy and practice at both national and subnational levels (6). This research identified there were insufficient opportunities for partnerships, nutrition education and training, and resourcing and financing to meet healthy eating standards. Additionally, there was inadequate guidance to implement the healthy eating standards outlined in the *National Quality Standards* at the national level. Beyond the ECEC setting, interventions to improve home food availability and accessibility and regulate unhealthy food marketing directed at children are needed to support families and ensure consistency between home and ECEC food environments. Addressing and incorporating these policy-level actions within a systems approach is essential to support the effective implementation of healthy eating interventions in ECEC settings.

### *6.3.2 Multisectoral partnerships*

This research highlights the need for multisectoral partnerships to address fragmented systems of support. The findings from the qualitative studies with directors, educators and cooks highlighted a complex environment with competing demands and competing priorities for available resources. These findings are consistent across the Australian context (7). Implementation of healthy eating interventions may be more likely to succeed if these complexities are considered. Multi-component

interventions provide opportunities to meet multiple curriculum requirements to better align with ECEC priorities and fit within existing systems to facilitate implementation (8). Strengthening connections between healthy eating practices and the outcomes outlined in the Early Years Learning Framework is recommended to bring food and nutrition to the forefront of planning. This may improve alignment with ECEC service priorities, given the emphasis on meeting the NQS, and help to alleviate the increasing demands for time and resources. Strategies to strengthen connections include integrating healthy eating with social and emotional learning, connection to community, and recognising cultural diversity (9, 10).

Improving the impact of multi-component evidence-based interventions requires multisector support that aligns with the competing demands of services. This provides a coordinated approach to support ECEC services in meeting priorities around food and nutrition such as supporting the local food system, community connections and meeting government guidelines and standards (**Chapter Four)**. In the states and territories that currently provide state-wide support for healthy eating, initiatives are delivered by local health departments or not-for-profit organisations funded by state governments (11). As such, multisector partnerships at the subnational state and local level are necessary. For example, in NSW implementation support from local health services through the *Munch & Move* initiative was identified as an important facilitator for menu planning and healthy eating resources (**Chapter Four** and **Chapter Five**). In addition to *Munch & Move*, stronger relationships with local councils could benefit implementation given their connections with community organisations. Local councils play an essential role as intermediaries linking national government and communities and have previously been identified as key stakeholders for improving child health and wellbeing (12). Additionally, Australian local councils play an important role in managing the local food system and have policies and programs to enforce food safety regulation, promote local food production and provide safe drinking water, reduce food waste, and educate the community on food system issues (13, 14). Local councils are ideally placed to support the ECEC sector and may already have existing relationships with services to implement composting and recycling initiatives (**Chapter Four**). In Australia, some published examples describe partnerships where local councils have installed

vegetables gardens, worm farms, and compost bins in ECEC services, as well as partnerships to establish local community gardens (14). However, there is limited evidence on the effectiveness of these partnerships in improving children's dietary outcomes. Further research is warranted to examine their impact and assess whether partnerships between local council and ECEC services are a feasible strategy for promoting healthy eating. Furthermore, directors and educators highlighted benchmarks and learning outcomes outlined by the NQF as important factors influencing planning and delivery of healthy eating policies and practices. Governing bodies have been identified as key stakeholders necessary for strong leadership and ongoing sustained implementation of healthy eating interventions in the ECEC setting (15). In Australia, there are different regulatory authorities across each state and territory that administer the NQF and approve and lead the quality rating of services, usually managed by each state and territory's education department. As such, the education sector plays an important role in supporting ECEC services.

Findings from this research suggest recommendations for stronger collaboration between regulatory authorities and government sectors including education, health, and local councils to support ECEC services. Feasibility of a state-wide government funded healthy eating service that brings together these key stakeholders to support ECEC services could be explored in jurisdictions without current healthy eating support. Findings from this thesis highlight key elements that would make such a service more effective, namely, a directory to assist directors with locating resources related to healthy eating information and providing opportunities for professional development and funding (**Chapter Four**). The proposed initiative can also support ECEC services to identify and facilitate external networks such as partnerships with local community gardening organisations to support ECEC services to build fruit and vegetable gardens (**Chapter Four**). Additionally, the initiative should include opportunities for ECEC services to connect with other services such as online discussion boards to foster a 'community of practice'. Findings from **Chapter Five** emphasise that these opportunities are particularly relevant for cooks who felt alone and isolated in their roles. For instance, as part of the web-based nutrition education resource Supporting Nutrition for Australian Childcare (SNAC), an online forum was included to increase the sense of community among ECEC

staff. It was found that the online forum increased shared emotional connection between members (16). Further research using a system-based approach is necessary to develop these partnerships and identify subsequent actions. For instance, the 'CONNECTS-Food' system map was developed to identify the key factors influencing primary school children's diets in the UK and identified potential actions, interventions and policies (17). This approach involved workshops with key stakeholders using a group model building approach and has been used to co-design resources for schools. Research applying this in the ECEC setting in the Australian context is recommended.

### *6.3.3 Professional development and sector support to build workforce capability*

This research highlighted the lack of access to education and support for educators and cooks needed to implement healthy eating interventions in the ECEC setting. Findings from the scoping review presented in **Chapter Three** showed that provision of staff training in the ECEC setting had positive impacts on children's dietary outcomes. However, educators and cooks reported limited opportunities for nutrition education before entering the workforce, leaving many feeling unprepared and overwhelmed (**Chapter Five**). Furthermore, professional development opportunities to enhance nutrition knowledge and skills once entering the workforce were scarce. Directors were committed providing healthy eating training to their staff but found limited access to affordable opportunities (**Chapter Four**). This is consistent with cross-sectional evidence that healthy eating training remains poorly implemented in ECEC services across Australia (18, 19).

Currently in Australia, educators must complete a Diploma of Early Childhood Education and Care, or a Certificate III in Early Childhood Education and Care program. ACECQA requires qualifications to include curriculum content to support educators to "promote and provide healthy food and drinks" (20). However, the extent to which this content is delivered in practice remains inconsistent. A qualitative study with Australian early childhood education and care staff found that while most participants receiving training about menu planning and food safety, there was minimal coverage of basic nutrient concepts and healthy feeding practices such as positive role modelling and managing

fussy eating (21). In another study with Australian educator's, discrepancies were noted between perceived knowledge and observed practices, particularly around feeding practices (22). Although cooks and chefs are often responsible for menu planning and food preparation, there are no nutrition training requirements for cooks and chefs in the ECEC setting (23). Consistent with other Australian studies, directors, educators and cooks often relied on personal knowledge, experiences and interest when implementing healthy eating practices (23, 24). However, personal beliefs do not always align with evidence-based best practice guidelines (24). Increasing access to nutrition education and training is essential considering the differences in nutrition training prior to entering the workforce between educators and cooks and the reliance on personal nutrition experiences.

In **Chapter Four,** directors recommended online training modules to support staff nutrition knowledge and skills. Establishing a system for professional development using technology may be a cost-effective way for wide-scale implementation of nutrition education across the sector. Research findings from the Support Nutrition Australian Childcare (SNAC) program implemented in Australia demonstrated that online professional development and resources improved nutrition knowledge and confidence about adequate food group serving sizes (25). Additionally, online menu planning tools have shown to be effective at improving menu adherence to dietary guidelines and improvements in children's dietary outcomes (26). The development of a national, government-funded online learning module for ECEC staff is recommended to address insufficient nutrition education and training opportunities, similar to initiatives implemented in the aged care setting. The *Improving Food in Aged Care through Education and Training* program is a free nutrition education and training for aged care chefs and cooks provided by the Australian Government Department of Health and Aged Care (27). In addition to online learning modules, the initiative also provides state level training hubs that bring together cooks and chefs working in aged care, a 12-month trainer mentor program, and online professional community. However, alignment of food provision guidelines between Australian states and territories is required prior to the implementation of national modules in the ECEC setting. Currently, food provision guidelines specify that 50% of children's daily intake, based on the Australian Dietary Guidelines 2013, should be provided in care in most jurisdictions except the

Northen Territory where no information is provided (28). However, the guidelines vary in number of serves of fruit, meat and dairy food groups that should be provided to children while in care (28). This may be due to the differences in parameters, such as reference age groups, used to determine the number of serves while in care. Notably, the largest differences in the guidelines relate to recommendations for whether EDNP foods can be included on the menu and how often EDNP foods such as Milo, ham, bacon, and sausages can be included on the menu (28). In NSW, Tasmania and Victoria it is specified that EDNP foods should not be included on the menu, while Queensland and South Australia allow some EDNP foods to be offered (28).

Findings from the qualitative studies presented in **Chapter Four** and **Chapter Five** suggest a multimodal approach may be beneficial as directors, educators, and cooks had preferences for both online and more tailored face-to-face support. Evaluation of the Learning, Eating, Active Play, Sleep (LEAPS) professional development program for early childhood educators in Queensland showed an improvement in knowledge of nutrition guidelines and intention to engage with parents and children (29). The intervention involved online reading and face-to-face professional development. For instance, online learning modules which can be easily accessed and support services in staff orientation, can be delivered in conjunction with existing government funded state-wide services such as *Munch & Move* to provide tailored face-to-face support. A co-design approach to develop ECEC sector professional development may support feasibility, acceptability, and efficacy of implementing online learning modules in the Australian context (30).

### *6.3.4 Collaborative partnerships with families*

**Chapter Two** and **Chapter Three** highlighted inconsistent evidence on the impact of interventions targeting parental nutrition knowledge and skills on children's diets, despite being the most frequently addressed determinant. In a Cochrane review of healthy eating interventions, parent nutrition education alone had little to no impact on children's fruit and vegetable intake (1). However, there is promising evidence supporting multicomponent ECEC-based interventions involving parents are

associated with improved nutrition behaviours in children (31). Global, national and state-level guidelines emphasise the importance of working with families and engaging parents with healthy eating (6, 32, 33). Findings from **Chapter Four** and **Chapter Five** revealed that directors, educators, and cooks acknowledged the importance of partnerships with parents, but cited challenges with engaging parents and meeting the conflicting expectations of parents versus guidelines. Challenges with engaging parents in healthy eating and parental expectations in the ECEC setting have been described in previous studies. Organisational factors that support high parent engagement with healthy eating include a centre culture that fosters parent engagement and that prioritises collaboration with parents rather than working for families, low staff turnover, practices for fostering communication amongst staff and parents, and having strong relationship with parents (34). Although communication is an important factor for engaging parents, ECEC providers reported multiple barriers to communicating with parents, including lack of time from both ECEC staff and parents, lack of staff confidence and skills to discuss nutrition without upsetting or offending parents, and limited access to resources (35). Differences in parent and ECEC provider perspectives of the challenges parents face in promoting healthy eating may be a further barrier to communication (36).

ECEC-based interventions should aim to support partnerships with families and remove barriers to communication. Further professional development for ECEC staff to increase their confidence to address and engage with parents may be effective (29). Additionally, findings from interviews with directors presented in **Chapter Four** suggest a need for more resources to support first time parents. Given the discrepancies between ECEC and parent perspectives of healthy eating challenges, further research with both ECEC staff and parents to identify relevant topics is recommended. Broader policy and environmental actions are also recommended to foster collaboration between ECECs and families. Organisational policies to strengthen a culture of working with families, effective workflows to enable strong communication between staff within ECEC services, and strong relationships between ECEC services and parents are factors to facilitate high engagement from families (37).

In **Chapter Four**, directors also identified a need for interventions involving parents in the home setting. A systematic review of ECEC-based interventions involving parents found that interventions

actively involving parents through parent participation components, and parent-delivered activities were associated with greater improvements in children's eating behaviours (31). For example, Health, Exercise, Nutrition for the Really Young (HENRY) is an obesity prevention program that has been delivered at scale in the UK for over ten years, providing support to parents and caregivers and training to upskill the ECEC workforce. The program and training components have increased both staff knowledge and confidence in having challenging conversations with parents and has demonstrated improvements in children's dietary outcomes (38). National childcare programs such as the Child and Adult Care Food Program (CACFP) in the US which also provide nutrition education to parents, show less perceived barriers and as such may be in a better position to implement healthy eating interventions and adhere to nutrition standards (39). Translation of a similar program in the Australian context warrants further research. There are opportunities to strengthen parent partnership and address the disconnect between settings by building on existing state government support service such as *Munch & Move* in NSW and the *Healthy Eating Advisory Service* in Victoria, Australia. Given the emphasis on collaborative partnerships between ECEC and families, further investigation of how to address the interactions between parents and determinants in the ECEC setting should be explored.

### *6.3.5 Strengthening nutrition guidelines and policy*

Findings from the scoping review presented in **Chapter Three** found that interventions manipulating the nutritional composition of foods provided to children were effective in improving dietary outcomes. These interventions included substituting high energy meals and snacks and increasing portion sizes of fruit and vegetable offered in the ECEC setting. This emphasises the importance of adopting nutrition guidelines to define the number of food group serves required to meet children's nutritional needs across the ECEC setting. However, the evidence suggests menu compliance with nutrition guidelines is low. An analysis of menus from long day care centres in NSW found no services were compliant with the recommended serves for vegetables and most services were not compliant with recommended number of serves for meat, fruit, breads and cereals, dairy, and discretionary foods (40). Services that received training and support for menu planning were more

likely to have higher menu compliance (40). In **Chapter Three, i**nterventions addressing the ECEC food environment to improve menu compliance showed mixed outcomes on children's diets. Findings from the qualitative studies presented in **Chapter Four** and **Chapter Five** suggest that government-endorsed *Caring for Children* nutrition guidelines, in conjunction with implementation support from the *Munch & Move* initiative were facilitating factors for menu planning in the context of NSW.

Additionally, findings from **Chapter Four** indicate that the implementation of healthy eating practices beyond menu planning, such as creating supportive mealtimes and implementing healthy eating learning experiences, was largely informal and not embedded into formal policy. It was noted that centre nutrition policies did not include details for healthy eating learning experiences and as such, these experiences occurred sporadically. A cross-sectional study of centre-based ECECs in Victoria, Australia found that although centres had written nutrition policies, many showed weak language and lacked comprehensiveness and strength (41). Evidence suggests that implementation support to develop comprehensive and well-defined nutrition policies that are tailored to the specific context of individual centres is a key enabler in fostering healthy food environments in the ECEC setting (7).

Findings from **Chapter Five** suggest there are differences in healthy eating practices between ECEC services and that further guidance from regulatory authorities is needed to ensure consistent implementation of healthy eating standards across the ECEC sector. Strengthening the NQS through the implementation of comprehensive nutrition best practice standards may enhance the consistency of healthy eating practices across service types. However, the introduction of additional standards and guidelines should be accompanied by adequate support to ensure feasibility and effectiveness. Directors, educators, and cooks expressed concerns about the feasibility of nutrition guidelines in NSW, commenting on the lack of acknowledgement of the complexities within the ECEC setting (**Chapter Four** and **Chapter Five**). Implementation support to operationalise nutrition standards should consider key contextual factors identified in **Chapter Four** and **Chapter Five**. For example, supporting resources and professional development for ECEC staff and parents should include strategies to manage food waste, budget constraints, allergy management, cultural diversity, and

challenges with fussy eating. It is acknowledged that the sample sizes in these studies were small and as such, future research with more diverse samples is recommended to understand differences in contextual factors. It is important to explore a wide range of experiences considering the diversity of the ECEC setting with variations service delivery in centre-based and family day care, food provision methods, and level of healthy eating support across jurisdictions.

### *6.3.6 Allocating adequate resourcing and financing*

The studies presented in this thesis contribute to the growing body of evidence supporting an increased investment in the ECEC setting to ensure children have access to high-quality education and care. This includes investments to foster supportive environments that make healthy food and drinks the easy choice for children and families. The findings from the qualitative studies presented in **Chapter Four** and **Chapter Five** emphasise the need for the allocation of financing and resources to promote opportunities for educators and cooks to engage in healthy eating professional development. Although not all centres were restricted by budget, directors revealed that cost of living challenges were influential factors in planning and implementation of healthy eating policies and practices. Directors prioritised resources to cover the increasing cost of food, mandatory training, and staff wages. Providing healthy eating learning experiences for children and healthy eating training for staff was considered extracurricular and not always prioritised. The challenges of promoting food and nutrition identified in the studies included in this thesis are consistent with challenges identified in the ECEC setting globally. In England, key stakeholders, including ECEC providers, managers, and researchers, reported that the early years sector was insufficiently consulted, undervalued, and chronically underfunded (42). In the US, educators described inadequate infrastructure, funding, and time to promote healthy eating for children (43).

Furthermore, the research presented in this thesis reinforces existing literature identifying the need for investment in the ECEC workforce. Despite commitment from directors, educators and cooks, implementation of healthy eating practices was inconsistent and dependent on staff capacity.

Attracting and retaining early childhood educators continues to be a challenge across the Australian ECEC sector (44). Emotional exhaustion from increasing demands and inadequate support, poor satisfaction with pay and benefits, lack of sense of belonging and connection, and poor health and wellbeing can contribute to educators' intention to leave the industry (45, 46). Burnout and poor health and wellbeing of educators have been well studied, however, there is limited evidence describing the health and wellbeing of cooks in the ECEC setting. In **Chapter Five**, cooks reported feeling undervalued, disconnected from the rest of the industry, and overwhelmed by increasing demands around menu planning and food provision. As such, further research to explore the professional wellbeing of cooks is warranted.

To address underlying workforce challenges and ensure the success of nutrition intervention in the ECEC sector, a systems approach leveraging social, economic and nutrition policy is recommended. A national approach to recognise the value of ECEC through increases in pay has been identified as a key priority to addressing workforce retention and workplace conditions (44). In 2024, the Australian government announced a 15% pay increase for the ECEC workforce as part of a grant agreement delivered through the Child Care Subsidy System (47). Further investment in the ECEC setting through healthy food subsidies is recommended to increase the availability and accessibility of healthy foods (**Chapter Three**). Evidence from the CACFP implemented across the US suggests that providing reimbursements to childcare providers for meals and snacks can increase adherence to nutrition standards (48). Nutrition assistance programs implemented at the national or state level can increase the availability and accessibility of fruits and vegetables and address food insecurity in disadvantaged communities, but further research is needed to increase the success of improving children's diets (49).

Tailored implementation support is recommended with further support needed for services in remote or regional area, preschools, and smaller services (19). Findings from the qualitative studies presented in **Chapter Four** and **Chapter Five** highlight the differences in available resources and funding between ECEC services. Some participants identified that profit maximisation strategies adopted in for-profit services were barriers to healthy eating, while others from both for-profit and not-for-profit

services highlighted greater availability of resources for food and nutrition in these services. This aligns with cross-sectional evidence indicating variations in implementation of healthy eating practices between for-profit and not-for-profit centres (19). ECEC directors identified barriers for smaller services including less flexibility for budget, fewer partnerships and a decreased capacity for research to support healthy eating (**Chapter Four**). Amending underlying issues related to funding and resourcing within the sector may increase workforce and sector capacity to improve implementation of healthy eating policies and practices.

### *6.3.7 Beyond the ECEC setting*

Addressing determinants beyond the ECEC setting is necessary to ensure a consistent approach across all settings that children interact with. This will also ensure the benefits from successful implementation of ECEC-based intervention on children's diets are not attenuated by external factors.

#### *6.3.7.1 Healthy food subsidies and home food availability and accessibility*

Home food availability and accessibility was identified as a high research priority but there were limited studies addressing this determinant as reported in **Chapter Two**. Most studies addressing home food availability and accessibility were contextualised for North America, focusing on healthy food subsidies through federal nutrition assistance programs for low-income families. While these interventions improved availability and accessibility to fruits and vegetables, the evidence was inconsistent regarding its impact on children's dietary intake (**Chapter Three**). Social and economic policies that address predisposing determinants of household food insecurity and health inequities are needed to improve the impact of nutrition policies on home food availability and accessibility (50). There was limited evidence for interventions that leverage both social and nutrition policies outside of the US (**Chapter Three**). Similar to the US, *Healthy Start* is a government nutrition assistance program providing healthy food subsidies for low-income families implemented across the UK. In 2022, the scheme transitioned to digital payments from paper-based vouchers to reduce barriers to

registration for the program and increase participation (51). However, these studies were not included in the scoping reviews presented in **Chapter Two** and **Chapter Three** because they did not assess the impact of the interventions on children's dietary outcomes. There is currently no evidence to show that *Healthy Start* program participation is associated with increased fruit and vegetable expenditure (52). It is recommended that increased voucher value, assistance with application, reframing the scheme as a child's right to food and development to reduce stigma, and national leadership to improve implementation at the local level may improve impact (51). In Australia, it is estimated that between 4% and 13% of the general population experience food insecurity, with children being at higher risk of negative effects on academic, social, emotional, and health outcomes (53). Considering differences in the food landscape, the effectiveness of nutrition assistance programs targeting young children and families in the Australian context requires further exploration.

Furthermore, inconsistent practices between the ECEC and home food environments was a common barrier that emerged from the qualitative studies presented in **Chapter Four** and **Chapter Five**. Similarly in the Netherlands, childcare managers and workers identified the home setting as an important factor shaping healthy nutrition in childcare and described poor dietary habits in the home setting (54). A qualitative study conducted in the US found that educators were frustrated at the lack of consistency in parent expectations to provide healthy foods in the ECEC setting but not at home (55). In England, analysis of the UK National Diet and Nutrition Survey revealed that children consumed less energy dense meals, less added sugars, and more fruit when they were with formal childcare providers compared to when accompanied by parents (56). In **Chapter Four**, directors suggested healthy eating interventions should include a "hands-on" component for the home setting. Findings from **Chapter Three** identified that educator-delivered nutrition interventions that include both an ECEC and home environment component were found to improve children's diets. As such, the home food environment, and the interactions with the ECEC food environment, provides a key leverage point for intervention.

The research in this thesis underscores the need for further research to identify effective strategies for reducing availability and consumption of EDNP foods and SSB in the home setting. In the scoping

review presented in **Chapter Three**, the majority of studies that addressed home food availability reported no difference on children's EDNP food and SSB intake. In **Chapter Five,** ECEC staff expressed frustrations at families having discretionary foods such as chocolates available for children at pick up. Evidence demonstrates that household food insecurity is associated with higher consumption of ultra-processed foods, such as EDNP and SSB, however no significant trends were observed for fruit and vegetable intake (57). This may suggest that fruit and vegetable interventions are needed for all children universally, in addition to targeted support to reduce EDNP and SSB intake in households experiencing food insecurity.

#### *6.3.7.2 Government regulations for unhealthy foods*

Findings from the scoping review presented in **Chapter Three** identified that interventions targeting policy-level determinants reduced consumption of EDNP foods. Consistent with the findings presented in **Chapter Three**, a systematic review of studies that aimed to reduce consumption of EDNP foods and SSB found that government level economic interventions are needed (58). Results from a systems dynamic model exploring the effect of policy interventions on the prevalence of child and adolescent obesity in Australia revealed that a 20% SSB tax was the most promising intervention when individually implemented (59). However, implementation of a portfolio of prevention interventions were observed to have a synergistic effect and were more effective for sustained health improvements compared with single policies (59).

Findings from the scoping review presented in **Chapter Two** and **Chapter Three** contribute to the evidence for the need for stronger government regulations to protect children from harmful food marketing. Studies examining government regulations such as food labelling and food advertisement regulations were scarce, and the only example of implementation was in Chile. The Food Labelling and Advertising Law implemented in Chile involves coordinated implementation of a suite of interventions across multiple levels including mandated front of package warning labels, restrictions in child-directed food marketing, and banning sale or promotion of EDNP foods in the ECEC and

school settings (60, 61). Promising results demonstrating improved nutrient intake have been observed in pre-school children and the school setting, but further research is needed to evaluate efficacy of actions in out-of-school settings (61, 62). Current studies evaluating food retail policies such as zoning laws to restrict the supply of unhealthy foods and drinks sold around schools show limited effect for improving dietary outcomes (63, 64). In Australia, children are exposed to high levels of unhealthy food advertising surrounding schools and on children's routes to schools (65, 66). Research on outdoor food and drink advertising around ECEC settings is underexplored. In a scoping review of outdoor food marketing on  eating behaviour and health, only two of 53 studies specifically explored the ECEC setting (67). Government regulations to restrict unhealthy food and drink advertising in outdoor spaces and government owned assets such as buses and train stations have been shown to be feasible, but no studies have reported on the health or economic impacts (68). Currently, only two Australian jurisdictions have implemented or plan to implement restrictions. In 2015, the Australian Capital Territory Government implemented a ban on unhealthy food and drink advertising on government run bus and light rail services (68). From July 2025, the South Australian government will implement policies to restrict the advertisement of unhealthy food and drinks on public buses, trains, and trams (69). Studies to examine the potential economic implications on revenue generated by advertising and health impacts on children's diets are needed and may provide evidence for investment in other states and territories.

In Australia, there are no government regulations that specifically target and protect children from unhealthy food marketing (70). A shift from industry self-regulation to cohesive policy action focusing on child-directed food marketing may be an additional measure necessary to improve children's diets. The Food for Health Alliance (formerly Obesity Policy Coalition) recommends a government regulatory scheme which applies to all food companies and fast food chains and includes the restriction of child-directed advertising on television and other digital media platforms, and restricting marketing such as cartoons and characters on packaging of unhealthy products (71). This is an important leverage point if we are to meet targets outlined by the Australian *National Preventive*

*Health Strategy 2021-2030* to reduce the proportion of children's total energy intake from discretionary foods to less than 20% by 2030 (72).

## 6.4 Conclusion to chapter and thesis

Children's diets are shaped by a complex set of determinants. The comprehensive scoping review and qualitative studies conducted as part of this thesis provide a clear and detailed "birds-eye view" of the determinants influencing children's diets. This thesis makes an important contribution to knowledge and practice by consolidating the large evidence base and identifying leverage points within the ECEC setting and broader food system to improve children's diets. This thesis demonstrated that programs are available to promote optimal diets for children. However, cohesive policy action is needed to address contextual factors influencing the implementation of healthy eating interventions to support translation into sustained population-level impact. This thesis generated recommendations for key policy-level actions to support implementation of healthy eating policies and practices in centre-based services. Multisectoral partnerships between regulatory agencies, health, education, and local government are recommended to enhance coordinated support for ECEC services. The development of online learning modules in addition to state-wide support services is proposed to address the need for better nutrition education and training. The development of resources to support communication and healthy eating programs is recommended to increase parent engagement and foster collaborative partnerships with parents. Detailed food provision guidelines and healthy eating support provided by local health services were identified as key facilitators for menu planning in the NSW context. Strengthening healthy eating standards by ensuring consistent nutrition guidelines and state-wide support is available to ECECs across all jurisdictions in Australia is recommended. However, implementation of regulations and guidelines requires investment in the ECEC sector to address underlying workforce and funding issues. Beyond the ECEC setting, strategies to improve home food availability and accessibility and reduce consumption of EDNP foods and SSB warrants further research. The ECEC setting can be leveraged through implementation of multi-component healthy eating programs that actively involve educators, cooks, parents and children. This should include

social and economic policy to address food insecurity and inequities such as nutrition assistance initiatives. Cohesive policy action is recommended to protect children from unhealthy food marketing, including national nutrition guidelines restricting provision of unhealthy foods and drinks in the ECEC setting and policy to restrict marketing on television, digital platforms including social media, and product packaging. A coordinated systems approach to address leverage points identified in this research is recommended to optimise synergistic effects. By providing a broader viewpoint, the findings from this thesis highlight how determinants of children's diets are being addressed and how recommendations fit together to inform coherent policy action to improve the diets of Australian children.

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# Appendices

**Appendix 1: Human Research Ethics Approval**

**Appendix 1.1** Approval Letter

*(Appears on next page)*

**Address for all correspondence**
Research Ethics and Governance Office
Royal Prince Alfred Hospital

Telephone: [redacted]
Email:
Reference: X23-0379 & 2023/ETH02140

23 October 2023

**This letter constitutes ethical approval only. You must NOT commence this research project at ANY site until you have submitted a Site Specific Assessment Form to the Research Governance Officer and received separate authorisation from the Chief Executive or delegate of that site.**

Dear Professor Allman Farinelli,

**Re: Protocol No X23-0379 & 2023/ETH02140 - "How does context influence the implementation and sustainment of nutrition interventions in the early childhood education and care setting? A qualitative study exploring directors, educators and cooks' perspectives."**

Thank you for submitting the above research proposal for single ethical and scientific review. This project was first considered by the Sydney Local Health District Human Research Ethics Committee (HREC) – RPAH Zone at its meeting held on 11 October 2023.

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's *National Statement on Ethical Conduct in Human Research*, the *CPMP/ICH Note for Guidance on Good Clinical Practice* and the *National Clinical Trials Governance Framework.*

I am pleased to advise that final ethical approval has been granted based on the following:

- The research project meets the requirements of the *National Statement on Ethical Conduct in Human Research (2007) – updated 2018*.

The documents reviewed and approved include:

- HREA (Version 1, 22 September 2023)
- Protocol (Version 2,18 October 2023)
- Participant Information Sheet (Version 2, 18 October 2023)
- REDCap Survey (Version 2, 18 October 2023)
- Email and Telephone Invitation Template (Version 2, 18 October 2023)
- Communications Template (Version 2, 18 October 2023)
- Recruitment Flyer (Version 2, 18 October 2023)
- REDCap Not eligible Notice (20 October 2023)

- Semi Structured Interview Guide (Version 2, 18 October 2023)
- Master Code Sheet (Version 2, 18 October 2023)
- Research Data Management Plan (29 September 2023)

'The HREC has provided ethical and scientific approval for the following sites:

1. Charles Perkins Centre, University of Sydney, NSW
2. SLHD Health Promotion Unit, NSW
3. ECEC Centres located in SLHD, NSW

For sites outside of NSW/ACT REGIS, a copy of this letter must be forwarded to all site investigators for submission to the relevant Research Governance Officer.

**Please note the following conditions of approval. The conditions listed in this approval letter should be comprehensively reviewed and understood by all members of the research team:**

1. HREC approval is valid for five (5) years subject to the supply of annual progress reports. The first report should be sent to the HREC by **23/10/2024.** You must also provide an annual report to the HREC upon completion of the study. This will be through a submission of a milestone in REGIS, see REGIS Quick Reference Guide (QRG): Submitting Annual Progress or Final Report (Milestone).

   **Important notes:**
   - **Ethics expiry:** An ethics extension amendment should be submitted prior to the ethics approval expiry date if the study is continuing beyond that date. This will be through a notification of an ethics amendment via REGIS, see REGIS QRG: Ethics Amendment - Completing and Submitting. Projects that are 12 months past the ethics expiry without submitting an ethics extension amendment will automatically be **suspended**.
   - **Milestones:** The status of any pending annual progress report that is six or more months past the due date will automatically be changed to 'Not Achieved'. The Research Office should be contacted to create a replacement milestone for the calendar year covered by the 'Not Achieved' milestone. The Committee relies on these reports to verify that the conduct of research complies with the approved protocol and remains ethically acceptable. Failure to submit regular or ongoing reports may result in your **ethics approval being withdrawn.**

2. In accordance with the National Statement, chapter 4.7; you must seek ethical approval from the HREC of the Aboriginal Health and Medical Research Council (AHMRC) if you intend to use Aboriginal and /or Torres Strait Islander status in any presentation or publication. See Research Office website for more information.

3. The study procedures as listed in the protocol must be followed at all times. See *The Australian Code for the Responsible Conduct of Research.*

4. All study personnel must be trained in the study protocol and aware of their role and responsibilities with respect to the research. All new personnel must be appropriately onboarded.

5. **Ethics Amendments:** Any proposed changes to the research protocol should be submitted to the HREC before those changes are implemented, such as changes to:
    - The general conduct of the research, including new aims or sub-studies
    - Any study procedures or data collection/management
    - CPI, site PI, adding students or other study personnel
    - The period covered by the ethics approval, i.e, to request an extension
    - The addition of sites

    Updated study documents should be submitted as a tracked and clean copy with new version number and date. This will be through a notification of an ethics amendment via REGIS, see REGIS QRG: Ethics Amendment - Completing and Submitting. See the Research Office website for more information on who can submit an amendment.

6. If the project is discontinued at a site before the expected date of completion, you must notify the HREC with reasons provided. It is also important to ensure study closure and completion processes are carried out in accordance with the Research Data Management Plan, Good Clinical Practice and local governance procedures. This will be through a notification of an ethics amendment via REGIS, see REGIS QRG: Ethics Amendment - Completing and Submitting. The site Research Governance Officer should also be notified following ethics acknowledgment, see REGIS QRG: Governance Amendment - Completing and Submitting.

7. You must immediately report anything which might warrant review of ethics approval, including unforeseen events that might affect continued ethical acceptability of the project. Examples include, significant safety issues, serious breaches, participant complaints, privacy breaches. This will be through a notification via REGIS, see REGIS QRG: Clinical Trial Safety Reporting (for clinical trials) or Ethics Amendment - Completing and Submitting.

8. **Serious breaches:** Serious breaches and complaints should be reported in accordance with NHMRC Guidance document: Reporting of Serious Breaches of Good Clinical Practice (GCP) or the Protocol for Trials Involving Therapeutic Goods 2018. **All complaints should immediately be reported to the HREC within 24 hours of being notified.** This will be through a notification via REGIS. This will be through a notification via REGIS, see REGIS QRG: Clinical Trial Safety Reporting (for clinical trials) or Ethics Amendment - Completing and Submitting.

9. **Conflicts of interest:** Any changes to financial, business or other non-financial conflicts of interests related to this research should be declared to the HREC in accordance with the National Statement Chapter 5.4: Conflicts of interest. See also NHMRC guidance document Disclosure of interests and management of conflicts of interest. This will be through a notification via REGIS, see REGIS QRG: Ethics Amendment - Completing and Submitting.

**For your information at the end of this letter is a general checklist to assist you with following all the necessary steps to support the study's compliance throughout its full duration.**

Should you have any queries about the HREC's consideration of your project please contact the Executive Officer - (02) 9515 8200. The HREC Terms of Reference, Standard Operating Procedures, membership and standard forms are available from the website: https://www.slhd.nsw.gov.au/rpa/research/default.html

The HREC welcomes feedback from researchers on how the ethics review process can be improved or how researchers can be better supported. If you would like to provide feedback, please email the Research Office.

Researchers are encouraged to:

- Develop standard operating procedures for consenting in line with the National Standard Operating Procedures. (if applicable)
- Regularly visit REGIS for system updates and for notifications about their project.
- Regularly review the Research Office website for up-to-date information on ethics requirements, training opportunities and drop-in clinics. https://www.slhd.nsw.gov.au/rpa/research/default.html

The Human Research Ethics Committee wishes you every success in your research.

Yours sincerely,

Merela Ghazal
*Acting Executive Officer*
*Sydney Local Health District Human Research Ethics Committee – RPAH Zone*

## Research Study Compliance Checklist

| | Completed |
|---|---|
| **Study approvals** | |
| 1. Ethics Approval | |
| 2. Site Specific Authorisation at all sites | |
| **Study commencement** | |
| 3. Study personnel training and on-boarding at all sites | |
| 4. Develop Consent SOP | |
| 5. Data Management processes established per approved RDMP | |
| **Study conduct** | |
| 6. Check in REGIS for milestones' due dates & other updates (annual report milestones are due to be submitted each year on the ethics approval anniversary date) | |
| 7. All ethics amendments are notified to the HREC/RGO | |
| 8. All complaints/breaches reported to HREC | |
| 9. At end of 5 years, request ethics extension (if the study is ongoing) | |
| **Study closure** | |
| 10. Notify HREC/ RGO –final milestone (Closed post-analysis) | |
| 11. Ensure study documentation archived as per the approved Protocol | |
| 12. Ensure data is managed as per the approved Protocol | |
| 13. Report results to participants | |

**Appendix 1.1** Approval for General Amendment

*(Appears on next page)*

**From:** no_reply@regis.health.nsw.gov.au
**To:** [redacted]
**Cc:**
**Subject:** X23-0379 & 2023/ETH02140: Notification of an amendment to a research study - General Amendment (167268) - Approved
**Date:** Friday, 10 May 2024 9:37:31 AM

---

Date of Decision Notification: **10 May 2024**
**9.20/MAy24**
**Greater than low risk review pathway**

Dear Margaret Allman-Farinelli,

Thank you for submitting an Amendment for the following study;

**X23-0379 & 2023/ETH02140: How does context influence the implementation and sustainment of nutrition interventions in the early childhood education and care setting? A qualitative study exploring directors, educators and cooks' perspectives**

The Amendment has been reviewed on 10 May 2024, by the Executive Officer as delegated by the HREC Chair and has been approved.

Notification of an amendment to a research study - General Amendment with form ID 167268

The following documentation is included in this approval:

- Study Protocol (Version 3, 03/05/2024)
- Participant Information Sheet (Version 3, 03/05/2024)
- List of early childhood education and care centres located in SLHD and SESLHD (Version 1, 3/5/2024)
- Email and telephone invitation (Version 3, 3/5/2024)
- Recruitment Flyer (Version 1, 03/05/2024)

In accordance with the National Statement, chapter 4.7; you must seek ethical approval from the HREC of the Aboriginal Health and Medical Research Council (AHMRC) if you intend to use ATSI status in any presentation or publication.

It is noted that the Sydney Local Health District Ethics Review Committee (RPAH Zone) is constituted in accordance with the National Statement on Ethical Conduct in Human Research, 2023 (NHMRC).

**This email constitutes ethical and scientific approval only.**

***For NSW authorised sites (listed in REGIS): A Site General Amendment form will need to be submitted to each affected site. You are not required to upload this form or the ethics approved documents into the site form but you will need to identify this approved amendment form ID (167268).***

Please contact us if you would like to discuss any aspects of this process further, as per the contact details below.

Yours Sincerely,

**Keshani Ajith Piyantha**
**Assistant Administrator**
**Research Ethics & Governance Office | Royal Prince Alfred Hospital**
Missenden Road CAMPERDOWN NSW 2050
[redacted]
****COVID-19 Response****
https://www.slhd.nsw.gov.au/rpa/Research/covid19response.html
**For information about submitting an application through REGIS** https://www.slhd.nsw.gov.au/rpa/research/regis.html

**Appendix 1.2** Site Specific Assessment

Sydney Local Health District

*(Appears on next page)*

**From:** no_reply@regis.health.nsw.gov.au
**To:** [redacted]
**Cc:**
**Subject:** X23-0379 & 2023/STE03523: SSA - Authorised
**Date:** Tuesday, 21 November 2023 10:05:20 AM

Date of Decision Notification: 21 Nov 2023
Greater than low risk review pathway

Dear Mr Hyde Page,

Thank you for submitting the following Site Specific Assessment (SSA) for governance review;
X23-0379 & 2023/STE03523: How does context influence the implementation and sustainment of nutrition interventions in the early childhood education and care setting? A qualitative study exploring directors, educators and cooks' perspectives

The Application has been reviewed by the Chief ExecutivesDelegate who has determined the application has been AUTHORISED to begin at this site:
Sydney Local Health District (Site)

The following documentation is included in this authorisation:

- Protocol (Version 2,18 October 2023)
- Participant Information Sheet (Version 2, 18 October 2023)
- REDCap Survey (Version 2, 18 October 2023)
- Email and Telephone Invitation Template (Version 2, 18 October 2023)
- Communications Template (Version 2, 18 October 2023)
- Recruitment Flyer (Version 2, 18 October 2023)

Site authorisation will cease on the date of HREA expiry 23/10/2028.

The conditions listed in this authorisation letter should be comprehensively reviewed and understood by all members of the research team.

Data and Tissue:

- No data or tissue can be transferred either within Australia or overseas without the appropriate Agreement in place and signed by the Chief Executive of the SLHD.
- NSW Health Pathology (NSWHP) services only - researchers must ensure NSWHP agreements are submitted to the RGO for legal review and Chief Executive sign-off. The study must not commence without the agreements reviewed by the SLHD legal office and signed by SLHD Chief Executive. Principal Investigators are not authorised to sign agreements on behalf of the SLHD.

Medical Records: if you wish to access patient records from the Medical Records Department their head of department's signature must be provided via REGIS.

Aboriginal and Torres Strait Islander (ATSI) Data: In accordance with the National Statement, chapter 4.7; you must seek ethical approval from the HREC of the

Aboriginal Health and Medical Research Council (AHMRC) if you intend to use ATSI status in any presentation or publication.

Conflicts of interest: Any changes to financial, business or other non-financial conflicts of interests related to this research should be declared to the HREC in accordance with the National Statement Chapter 5.4: Conflicts of interest. See also NHMRC guidance document Disclosure of interests and management of conflicts of interest. This will be through an ethics amendment and should subsequently be submitted as a governance amendment once ethics approval has been granted.

Ethics Post-Approval Documentation:

- A copy of the annual report, accompanied by a copy of the HREC's acknowledgement letter, are submitted to this office as a REGIS Milestone for review. Please note, if the ethics application has been approved in REGIS the site annual report will automatically be submitted to the Research Governance Office (following HREC approval).
- Proposed amendments to the research protocol or conduct of the research which may affect the ongoing ethical acceptability or site acceptability of the project, and which are submitted to the lead HREC for review, are copied to this office accompanied by a copy of the HREC's acknowledgement letter.

Reporting breaches, complaints:

- Serious breaches, privacy or security breaches, patient or other complaints, should be reported to the Research Governance Office within 24 hours of being notified.

Research Personnel:

- Please note that you are responsible for making the necessary arrangements (e.g. identity pass, staff health checks, working with children checks) for any research team member who is not employed by the Sydney Local Health District and is conducting the research on-site at RPAH
- The appropriate documentation must be submitted to the RGO for authorisation before any external researcher is authorised to conduct research procedures at RPAH
- Student involvement: Site approval is granted on the assumption that all students and early career researchers are adequately supervised by the principal and senior investigators on a project. This supervision would ensure that all privacy concerns are met (including the completion of privacy undertaking agreements by participating students) and that both students and participants are supported in the conduct of the study in line with the approved research protocol.
- Personal Professional Indemnity: where appropriate, you should consult with your Medical Defence Union to ensure that you are adequately covered for the purposes of conducting this study.

For studies involving equipment provided by the sponsor: It is your responsibility to ensure that any study related equipment provided by the sponsor complies with any local clearance requirements. For example Biomedical Engineering equipment clearance requirements.

Checking website
You are encouraged to regularly review the Research Office website for up-to-date information on governance requirements, training and drop-in clinics.
https://www.slhd.nsw.gov.au/concord/ethics/default.html
https://www.slhd.nsw.gov.au/rpa/research/default.html

I wish you all the best with the Research

Yours Sincerely,
Estelle Ali
Acting Research Governance Officer
Research Ethics & Governance Office
Royal Prince Alfred Hospital
Missenden Road CAMPERDOWN NSW 2050
[redacted]
**COVID-19
Response**https://www.slhd.nsw.gov.au/rpa/Research/covid19response.html
For information about submitting an application through
REGIS https://www.slhd.nsw.gov.au/rpa/research/regis.html

**From:** no_reply@regis.health.nsw.gov.au
**To:** [redacted]
**Cc:**
**Subject:** X23-0379 & 2023/ETH02140: Notification of an amendment to a research study - Addition of a New Site - (166750) - Approved
**Date:** Monday, 13 May 2024 9:10:48 AM

---

Date of Decision Notification: **13 May 2024**
**Greater than low risk review pathway**

Dear Margaret Allman-Farinelli,

Thank you for submitting a Notification of an amendment to a research study - Addition of a New Site with ID (166750 for the following study;

**X23-0379 & 2023/ETH02140: How does context influence the implementation and sustainment of nutrition interventions in the early childhood education and care setting? A qualitative study exploring directors, educators and cooks' perspectives**

The Amendment has been reviewed on 13 May 2024, by the Executive Officer as delegated by the HREC Chair and has been approved.

**Notification of an amendment to a research study - Addition of a New Site with form ID 166750**

- **South Eastern Sydney Local Health District (Site)**

PI name: Jacqueline Chan
PI email: jacqueline.chan@sydney.edu.au

It is noted that the Sydney Local Health District Ethics Review Committee (RPAH Zone) is constituted in accordance with the National Statement on Ethics Conduct in Human Research, 2023 (NHMRC).

**This email constitutes ethical and scientific approval only.**
This project cannot proceed at any site until separate research governance authorisation has been obtained from the Institution at which the research will take place.

Please contact us if you would like to discuss any aspects of this process further, as per the contact details below.

Regards,

**Keshani Ajith Piyantha**

**Assistant Administrator**
**Research Ethics & Governance Office | Royal Prince Alfred Hospital**
Missenden Road CAMPERDOWN NSW 2050
[redacted]
****COVID-19 Response****
https://www.slhd.nsw.gov.au/rpa/Research/covid19response.html
**For information about submitting an application through REGIS** https://www.slhd.nsw.gov.au/rpa/research/regis.html

**Appendix 1.3** Email and telephone invitation template

Email template: for distribution by the Sydney Local Health District Health Promotion Unit

Dear Munch and Move Team,

You are invited to take part in a research study looking at the factors that help or hinder early childhood education and care services to carry out and continue to deliver healthy eating activities.

The study is being conducted by researchers from the University of Sydney to understand how we can change the food environment and policy to better support children's nutrition, growth, and development. It is being conducted by Jacqueline Chan to fulfil the requirements of a Doctor of Philosophy.

We would like to explore the perspectives of directors, educators and cooks. Participants will be re-imbursed with a voucher for their time.

For more information, please see the flyer and participant information sheet attached. Please forward and share this with your team.

Please don't hesitate to contact jacqueline.chan@sydney.edu.au if you have any questions or you would like to arrange a face-to-face meeting at your service to discuss.

Thank you for your time.

Kind regards,

Munch & Move team

Health Promotion Unit, Sydney Local Health District

Email template: for distribution by the South Eastern Sydney Local Health District Equity and Prevention Service

Dear Munch and Move Team,

You are invited to take part in a research study to help shape nutrition policies and practices in early childhood.

We want to hear from educators and cooks to understand what helps or hinders healthy eating in early childhood education and care. Participants will be re-imbursed with a voucher for their time.

The study being conducted by Jacqueline Chan at the University of Sydney as part of her Doctor of Philosophy.

For more information, please see the flyer and participant information sheet attached. Please forward and share this with your team.

Please don't hesitate to contact jacqueline.chan@sydney.edu.au if you have any questions or you would like to arrange a meeting at your service to discuss.

Thank you for your time.

Kind regards,

Munch & Move team

South Eastern Sydney Local Health District

**Telephone prompts**

*A maximum of two attempts will be made to contact each service. If the service does not answer, the investigator will try to call once more at a different time.*

Hi [insert name of ECEC service or staff member], my name is Jacqueline, and I am a PhD student from the University of Sydney. I found the contact details for your service through the ACEQA public register.

I am calling to invite you to take part in a research study looking at the factors that help or hinder early childhood education and care services to carry out and continue to deliver healthy eating activities.

The study is being conducted by researchers from the University of Sydney to understand how we can change the food environment and policy to better support children's nutrition, growth, and development. I am conducting this study to fulfill the requirements of a Doctor of Philosophy.

We would like to explore the perspectives of directors, educators and cooks. The study will involve a 30-40 minute one-on-one interview. Participants will be re-imbursed with a voucher for their time.

Would you be interested in participating in the study and/or sharing the study with your team?

| No | Yes |
|---|---|
| That is okay, thank you for your time.<br>[end call] | Great! Can I please confirm your email address to share the flyer and participant information sheet? This will have more information about the study. |

Do you have any further questions about the study at this stage?

Please don't hesitate to contact jacqueline.chan@sydney.edu.au if you have any questions or you would like to arrange a face-to-face meeting at your service to discuss further.

Thank you for your time.

**Appendix 1.4** Participant information sheet

*(Appears on next page)*

THE UNIVERSITY OF SYDNEY

**PARTICIPANT INFORMATION SHEET**

# *How does context influence the implementation and sustainment of nutrition interventions in the early childhood education and care setting? A qualitative study exploring directors, educators, and cooks' perspectives*

***Food Systems in ECEC***

| | |
|---|---|
| **Title** | How does context influence the implementation and sustainment of nutrition interventions in the early childhood education and care setting? A qualitative study exploring directors, educators, and cook's perspectives |
| **Short Title** | Food Systems in ECEC |
| **Project Sponsor** | The University of Sydney |
| **Principal Investigator** | Professor Margaret Allman-Farinelli |
| **Associate Investigator(s)** | Professor Philayrath Phongsavan<br>Professor David Raubenheimer<br>Alexander Hyde-Page<br>Jacqueline Chan |
| **Location** | Early childhood education and care services located in Sydney and South Eastern Sydney Local Health District |

## 1. Introduction

You are invited to take part in a research study looking at what helps early childhood education and care (ECEC) services to support healthy eating. The aim of the study is to find out what factors help or hinder ECEC services to carry out and continue to deliver healthy eating activities and how external factors such as access to funding, policies and guidelines play a role. As a director, educator, or cook at an ECEC service, you will provide an important perspective for this study.

The study is being conducted by Jacqueline Chan as part of the requirements for a Doctor of Philosophy at the University of Sydney under the supervision of:

- Professor Margaret Allman-Farinelli, Professor of Dietetics, Sydney Nursing School, Faculty of Medicine and Health
- Professor Philayrath Phongsavan, Professor of Public Health, Director Prevention Research Collaboration, School of Public Health
- Professor David Raubenheimer, Professor of Nutritional Ecology, Leonard P Ullmann Chair in Nutritional Ecology, School of Life and Environmental Sciences.

Jacqueline Chan is being supported by a University of Sydney scholarship, the One for All PhD Scholarship in Healthy Food Systems.

This Participant Information Sheet (PIS) will tell you what is involved in the study and help you decide whether you wish to take part. Please read this information carefully. If there is anything you do not understand or if you feel you need more information about anything, please ask. Before you decide, please feel free to talk things over with a relative, a friend or your manager.

## 2. Study Procedures

If you agree to participate in this study, you will be asked to complete an online survey. You will first be asked to complete a few questions to see if you are eligible for the study and provide electronic consent to participate. You will then be asked to complete a 10 minute survey. This will include 13 questions about your service, how food is provided, and about your background such as age, gender, education. This information is important for us to ask to help us understand more about you and how we tailor support resources.

You will then participate in a one-on-one interview held in-person at your service. The interview will include questions about healthy eating rules, activities or projects at your service, and the things within and outside your service that help or hinder you to deliver them. The interview will take approximately 30-40 minutes. The interview will be audio-recorded and transcribed into written format. Your interview transcript will be sent back to you for comment and/or correction. These notes will not contain any details that will identify you. If you would like to receive a summary of the findings, you can provide your contact details in the online survey.

## 3. Risks

The possible risks of participating in this study may include:

- Inconvenience from giving your time to complete the online survey (maximum 10 minutes) and interview (maximum 40 minutes).
- Discomfort such as negative feelings from talking about barriers to providing healthy eating at your workplace (maximum 40 minutes), being audio recorded or providing personal information such as racial or ethnic origin.

There is very low risk of social harms such as damage to networks or relationships from talking about relationships at your service during the interview. Interviews will be conducted one-on-one, and the data and final reports will not contain any information that can identify you or your service.

If you wish to talk to someone outside the research team due to any distress caused to you by the questions, you can contact support services:

- Beyond Blue for mental health support, call a counsellor on 1300 22 4636, or chat to a counsellor online at https://www.beyondblue.org.au/get-support
- Butterfly National Helpline for support about eating disorders or body image, call 1800 33 4673, or chat online at https://butterfly.org.au/get-support/helpline/
- Lifeline for crisis support, call 13 11 14, or chat online at https://www.lifeline.org.au/

## 4. Benefits

While we intend that this research study furthers public health nutrition knowledge and may improve healthy eating support for ECEC services and the diets of young children in the future, it may not be of direct benefit to you.

## 5. Costs

Participation in this study will not cost you anything, nor will you be paid.
However, you will be reimbursed a $30 electronic supermarket voucher for your time.

## 6. Voluntary Participation

Participation in this study is entirely voluntary. You do not have to take part in it. If you do take part, you can withdraw at any time without having to give a reason by emailing Jacqueline Chan (jacqueline.chan@sydney.edu.au). Whatever your decision, please be assured that it will not affect your relationship with your ECEC service, Sydney Local Health District, South Eastern Sydney Local Health District, or the University of Sydney.

If you decide to withdraw from the study, information collected up to that point will be included in the study and we will not collect any more study-related information from you. If you wish to remove your information from our study records, you can tell the researcher at the time of your withdrawal.

## 7. Confidentiality

All the information collected from you for the study will be treated confidentially. De-identified data (de-identified data means that you/your information will not be identifiable) will be stored on an online secure password protected research database managed by the University of Sydney, and the University of Sydney licenced Research Electronic Data Capture (REDCap), a secure web-based database application. Data will be recorded using unique ID codes. Any identifiable data such as name, email and phone number will only be used to contact you to arrange an interview time and re-imbursement. Only the researchers named on this form will have access to it. It will not be linked to any survey or interview data.

The data will be analysed by the researchers named on this form at the University of Sydney. All data for use in journal publications and presentations will be de-identified. The files will be retained for 5 years from the day the study is completed. Once the retention expires the files will be deleted.

Data collected up until the time you withdraw may be included in the study. If you do not want them to do this, you must tell the researchers at the time of your withdrawal. The study results will be used in a higher degree research project and may be presented at a conference or in a scientific publication, but individual participants will not be identifiable.

## 8. Storage of Data

The University of Sydney software licence for REDCap will be used for to manage the collection and storage of research data. REDCap is a secure, web-based, non-commercial, data management tool designed for research purposes. Data collected by REDCap is stored on servers in the University of Sydney data centre. Data is secured and regularly backed-up to protect privacy and confidentiality.

## 9. Future use of Data

The data collected in this project may also be used in future research studies and/or results of this study and de-identified data may be shared in future as part of the requirement for the

Doctor of Philosophy for Jacqueline Chan. Any stored data that is used for related research, will first be reviewed, and approved by an appropriately constituted Ethics Committee.

## 10. Further Information

If you have any questions or you would like to know more at any stage, please feel free to contact them at jacqueline.chan@sydney.edu.au.

This information sheet is for you to keep.

## 11. Ethics Approval and Complaints

This study has been approved by the Ethics Review Committee (RPAH Zone) of the Sydney Local Health District. Any person with concerns or complaints about the conduct of this study should contact the Executive Officer on 02 9515 6766 and quote protocol number X23-0379.

**Appendix 1.5** REDCap survey and e-consent form

*(Appears on next page)*

# Are you eligible?

Thank you for your interest in participating in the study.

Please complete the survey below.

| | |
|---|---|
| Which of the following early childhood education and care services do you work at?<br>If multiple, choose the one you work at the most. | ◯ Long day care<br>◯ Pre-school (non-government)<br>◯ Early learning centre (non-government)<br>◯ NSW Government pre-school<br>◯ Family day care<br>◯ Mobile service<br>◯ Other |
| Does your service only provide care for children with disability or additional needs? | ◯ Yes<br>◯ No |
| Does your service prepare and/or provide food (at least lunch and two mid-meals/snacks)? | ◯ Yes<br>◯ No |
| What is your role at the service? | ◯ Director/manager<br>◯ Educator<br>◯ Cook<br>◯ Other |

What is the postcode of the service where you are employed?
**If** multiple, choose the one you work at the most.

- ◯ 2000
- ◯ 2006
- ◯ 2007
- ◯ 2008
- ◯ 2009
- ◯ 2015
- ◯ 2016
- ◯ 2017
- ◯ 2018
- ◯ 2031
- ◯ 2037
- ◯ 2038
- ◯ 2039
- ◯ 2040
- ◯ 2041
- ◯ 2042
- ◯ 2043
- ◯ 2044
- ◯ 2045
- ◯ 2046
- ◯ 2047
- ◯ 2048
- ◯ 2049
- ◯ 2050
- ◯ 2129
- ◯ 2130
- ◯ 2131
- ◯ 2132
- ◯ 2133
- ◯ 2134
- ◯ 2135
- ◯ 2136
- ◯ 2137
- ◯ 2138
- ◯ 2139
- ◯ 2140
- ◯ 2190
- ◯ 2191
- ◯ 2192
- ◯ 2193
- ◯ 2194
- ◯ 2195
- ◯ 2196
- ◯ 2203
- ◯ 2204
- ◯ 2206
- ◯ 2207
- ◯ 2208
- ◯ 2209
- ◯ 2210
- ◯ 2010
- ◯ 2011
- ◯ 2019
- ◯ 2020
- ◯ 2021
- ◯ 2022
- ◯ 2023
- ◯ 2024
- ◯ 2025
- ◯ 2026
- ◯ 2027
- ◯ 2028
- ◯ 2029
- ◯ 2030
- ◯ 2032
- ◯ 2033
- ◯ 2034
- ◯ 2035
- ◯ 2036

- ◯ 2171
- ◯ 2172
- ◯ 2205
- ◯ 2216
- ◯ 2217
- ◯ 2218
- ◯ 2219
- ◯ 2220
- ◯ 2221
- ◯ 2222
- ◯ 2223
- ◯ 2224
- ◯ 2225
- ◯ 2226
- ◯ 2227
- ◯ 2228
- ◯ 2229
- ◯ 2230
- ◯ 2231
- ◯ 2232
- ◯ 2233
- ◯ 2234
- ◯ 2790
- ◯ Other

# E-consent

For further information about the study please download and read through the Participant Information Sheet attached. You may save a copy for future reference.

[Attachment: "2023_ETH02140 - C. Participant Information Sheet_V2_18102023.pdf"]

| | |
|---|---|
| Would you be interested in participating? | ◯ Yes<br>◯ No |

Thank you for taking the time to read about the study.

Close the browser to exit the form.

## Consent Form

First name

_____

Last name

_____

By signing this consent form, I indicate that I have read and understood the Participation Information Sheet.

I have been made aware of what will be involved in this study, including any known or expected inconvenience, risk or discomfort. I understand that the interview will be audio-recorded and then will be written as notes and be kept so that I cannot be identified for analysis. I understand that the University of Sydney software license for REDCap (Research Electronic Data Capture) will be used to manage the collection and storage of my research data. I have had an opportunity to ask questions and I am satisfied with the answers I have received. I freely choose to participate in this study and understand that I can withdraw at any time. I also understand that the research study is strictly confidential.

| | Yes | No |
|---|---|---|
| I hereby agree to participate in this research study | ○ | ○ |
| My service has agreed that I can participate in the study and complete the interview on site. | ○ | ○ |
| I would like to receive a summary of the study results by email | ○ | ○ |
| I consent to the future use of the research data | ○ | ○ |

Signature

Click "Add signature" to sign.

_____

Date participant consent

_____

**Please provide your email, telephone number (if preferred), the name of your service and availabilities so the research team can contact you to confirm an interview time.**
**This information will not be linked to your survey or interview responses and will be stored confidentially as outlined by the Participant Information Sheet.**

Email _____

Phone number _____

Name of service _____

Please choose the day(s) and time(s) you are available for your interview:
A researcher will contact you to confirm the day and time after you complete the survey.

| | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| 7:00 am | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8:00 am | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9:00 am | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10:00 am | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11:00 am | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12:00 pm | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1:00 pm | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2:00 pm | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3:00 pm | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4:00 pm | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5:00 pm | ☐ | ☐ | ☐ | ☐ | ☐ |

# Questionnaire

Before the interview, we would like to know more about you and your service. This section has 13 questions and is estimated to take about 10 minutes to complete.

**SERVICE CHARACTERISTICS**

**In this first section, we would like to ask some questions about your service.**

Which of the following best describes your service provider?

- ◯ For-profit
- ◯ Non-profit
- ◯ Community based
- ◯ Government run
- ◯ I don't know
- ◯ Other, please specify

If other, please specify

_____

What meals does your service provide? Select all that apply:

- ☐ Breakfast
- ☐ Morning Tea
- ☐ Lunch
- ☐ Afternoon Tea
- ☐ Late snack
- ☐ Dinner

How is food prepared at your service?

- ◯ All meals are cooked on-site
- ◯ All meals are outsourced
- ◯ There is a mix of meals cooked onsite outsourced

Please specify which meals are outsourced?

_____

How many children are enrolled at your service?

_____

**PARTICIPANT CHARACTERISTICS**

**The next questions are about your age, gender, cultural and ethnic background, education and experience in early childhood education and care. It is important for us to ask these questions to help us understand early childhood education and care services in the local area and whether different types of support resources are needed depending on background and experience.**

How do you describe your gender?

- ◯ Male
- ◯ Female
- ◯ Prefer not to say
- ◯ Other

Which age group includes your age?

- ◯ 18-29 years
- ◯ 30-39 years
- ◯ 40-49 years
- ◯ 50-59 years
- ◯ 60-69 years
- ◯ 70 years and over

| | |
|---|---|
| In which country were you born?<br><br>The countries listed were the most reported countries of birth in the 2021 Census. For all other countries of birth, please select the 'Other (please specify)' option. | ◯ Australia<br>◯ England<br>◯ New Zealand<br>◯ India<br>◯ Philippines<br>◯ Vietnam<br>◯ Italy<br>◯ Other, please specify<br>(_____) |
| What is your ancestry?<br>Provide up to two ancestries only. Examples of 'Other ancestry': Croatian, Serbian, Filipino, Tamil, Sinhalese, Hmong, Maori. | ☐ English<br>☐ Irish<br>☐ Scottish<br>☐ Chinese<br>☐ Italian<br>☐ Australian<br>☐ Other ancestry, please specify<br>(_____) |
| Do you use a language other than English at home?<br><br>If more than one language other than English, select the one that is used most often. | ◯ No, English only<br>◯ Yes, Mandarin<br>◯ Yes, Arabic<br>◯ Yes, Cantonese<br>◯ Yes, Vietnamese<br>◯ Yes, Italian<br>◯ Yes, Greek<br>◯ Yes, other, please specify<br>(_____) |
| What is your highest level of education? | ◯ Degree (Bachelor, Masters, Doctorate)<br>◯ Graduate or Advanced Diploma<br>◯ Certificate I-IV<br>◯ Secondary Education - Years 10 and above<br>◯ Secondary Education - Years 9 and below<br>◯ Other, please specify<br>(_____) |

## Appendix 2: Scoping review protocol

**Appendix 2.1** Scoping review protocol published on Open Science Framework

# Food system interventions targeting early childhood: a systematic scoping review protocol

Jacqueline Chan[1,2], Philayrath Phongsavan[2,3], David Raubenheimer[2,4], Margaret Allman-Farinelli[1,2]

1. Nutrition and Dietetics Group, Sydney Nursing School, Faculty of Medicine and Health, The University of Sydney, Sydney, New South Wales, Australia
2. Charles Perkins Centre, The University of Sydney, Sydney, New South Wales, Australia
3. Prevention Research Collaboration, Sydney School of Public Health, Faculty of Medicine and Health, The University of Sydney, Sydney, New South Wales, Australia
4. School of Life and Environmental Sciences, University of Sydney, Sydney, New South Wales, Australia

**Review questions**

1. What is the impact of food system interventions on the dietary outcomes in preschool children (aged 2-5 years) and how do they map to the determinants of nutrition and eating?
2. Which system determinants need further research and where are the leverage points within the food system for future interventions?

This study will present synthesised data in two separate manuscripts to report in-depth findings and remain within journal publication word limits. The first manuscript will report findings on intervention outcomes to answer research question 1 (what is the impact of food system interventions?). The second manuscript will report findings from mapping study interventions against the DONE framework to answer research question 2 (which system determinants need further research?). This change was made as there was a large number of included studies (n=179). No expected changes to the study results.

**Searches**

The Joanna Briggs Institute (JBI) methodology for scoping reviews (1) will be used to identify published studies for this systematic scoping review.

An initial scoping search was conducted on SCOPUS and MEDLINE to identify relevant articles, keywords and subject headings to inform the development of the full search strategy. A second full search will be completed across the following databases: MEDLINE (via Ovid), EMBASE, Global Health, The Cochrane Library (Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials (CENTRAL), Cochrane Methodology Register), ERIC, SCOPUS. The search will be restricted to studies published in the English language and between January 2000 and to the date the searches are run. The searches will be re-run prior to the final analyses and any further studies identified will be retrieved for inclusion. The full search strategy will be included in the final scoping review publication.

The search strategy was changed from searching the reference lists of *all included studies* to *systematic reviews only* to scan for additional studies not included in our search. The change was made as authors used a broad search strategy that captured a large number of studies for inclusion. No expected changes on the study results.

**Condition or domain being studied**

Public health nutrition interventions in the early childhood setting that have an impact on eating behaviours and diet quality in preschool children (aged 2-5 years).

**Participants/population**

Inclusion: Children of preschool age (2-5 years).

Exclusion: Children at primary school age (over 5 years) or infants and toddlers (under 2 years of age), children with clinical conditions or severe comorbidities.

**Interventions, exposures**

Food system interventions in the early childhood setting are defined as those targeting preschool children (aged 2-5 years) with the aim of improving diet quality. Interventions targeting the external food environment, personal food environment (individual, parent and household factors) and behaviours of caregivers and children will be included. These are the key determinants that children directly interact with within the food system (2).

Examples include interventions examining industry and government policy; physical environments in the retail/commercial, early childhood education and/or community setting; food procurement, preparation and feeding practices of parents and caregivers; availability and accessibility of healthy foods in the home environment; and eating practices and behaviours in children. Multi-component and/or combined healthy eating and physical activity interventions, such as childhood obesity prevention studies, will be considered for inclusion.

**Comparators/control**

Standard/usual care (children not exposed to any intervention), wait-list control or pre-test (baseline).

**Types of study to be included**

Inclusion: Studies examining the impact of an intervention including experimental and quasi-experimental studies will be eligible for inclusion. Additionally, prospective and retrospective cohort studies, case control studies, systematic reviews, meta-analyses and umbrella reviews that meet the inclusion criteria will be considered for manuscript one.

Only primary studies will be included in manuscript two. This change was made as study results will now be separated into two manuscripts and reviews are not applicable for mapping to the DONE framework. No expected changes to study results.

Exclusion: Studies with no intervention (e.g. cross-sectional studies) or studies that only report qualitative findings.

**Context**

Studies conducted in high-income countries (3) with modern food systems similar to Australia will be included. Studies in early childhood education, home and community settings will be included. Wider settings such as retail/commercial setting will also be included.

**Main (primary) outcomes**

Change in dietary intake in preschool children (aged 2-5 years) including food, energy intake, calorie and/or nutrients intake, diet quality and food and eating patterns.

**Additional (secondary) outcomes**

Parent and carer feeding practices and food provision, perception and preferences, nutrition related skills, knowledge and self-efficacy.

**Data extraction (selection and coding)**

Study selection

One researcher will apply eligibility criteria and screen title and abstracts for potentially relevant studies. Full texts will be retrieved and screened by two researchers against the eligibility criteria for inclusion in the scoping review. Researchers will be blinded to each other's decisions. The online Covidence platform will be used to record decisions.

Data extraction

The following data will be extracted from study documents: author, year of publication, and country of study, aims/purpose, participant information (study population, sample size, demographics), study design and methodology, intervention information (type/strategy, setting, year of study, duration, who delivered the intervention), outcomes and determinants of dietary intake addressed. Two researchers will independently extract data. If there is any missing data, article authors will be contacted for additional information. Extracted data will be recorded in an Excel spreadsheet.

Any disagreements at each stage will be discussed between the two researchers until a consensus is reached. If a consensus is not reached, a third researcher will be involved to decide.

**Strategy for data synthesis**

Extracted information regarding determinants addressed by study interventions will be mapped against the DONE Framework 2.0 (4) and corresponding outcomes will be synthesised. The DONE Framework 2.0 is categorised into four main socio-ecological levels (policy, environment,

interpersonal and individual) which are divided into 11 categories (stem-categories) and further divided into 51 sub-categories (leaf-categories).

**Analysis of subgroups or subsets**

None planned.

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## Appendix 3: Publications

**Appendix 3.1** Publication resulting from Chapter Two

*(Appears on next page)*

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Review Article

# Systems map of interventions to improve dietary intake of pre-school aged children: A scoping review

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ABSTRACT

Implementation and sustaining impact of early childhood nutrition interventions in practice remains a challenge. An understanding of the extent to which determinants across multiple levels of the food system are being addressed may improve success. This literature review aimed to synthesise the evidence on interventions targeting dietary intake and eating behaviours in preschool children using a systems approach.

Eligible studies included intervention studies targeting the dietary intake of preschool children aged 2–5 years in high income countries, published in English after January 2000. Interventions were categorised to the Determinants of Nutrition and Eating (DONE) framework for children developed and evaluated by experts across multiple fields. The framework maps and ranks 411 factors driving eating behaviours and nutrition and can be used to systematically summarise determinants. DONE ranks each determinant for its perceived research priority.

A total of 160 eligible studies were identified. Most interventions targeted interpersonal ($n = 101$, 63.1%) and individual ($n = 85$, 53.1%) level determinants, with fewer targeting environmental ($n = 55$, 34.4%) and policy level ($n = 17$, 10.6%) determinants. The most frequently addressed determinants were Parental Resources and Risk Factors ($n = 85$) and Children's Food Knowledge, Skills and Abilities ($n = 67$). These determinants had a Moderate research priority rating. Home Food Availability and Accessibility at the environmental level is classified as the highest research priority, however, only 15 of 160 interventions addressed this determinant.

This review highlights home food availability and accessibility as potential leverage points for future interventions to improve children's dietary intake and eating behaviours.

## 1. Introduction

Diet is a major risk factor for non-communicable diseases (NCDs). In 2017, dietary risk factors attributed to 11 million deaths and 255 million disability-adjusted life years globally (Afshin et al., 2019). Diets high in sodium and low in wholegrains, fruits, nuts and seeds, and vegetables were among the leading risk factors globally (Afshin et al., 2019; Melaku et al., 2019). Higher consumption of ultra-processed foods high in added sugar, saturated fat, sodium, and additives, is associated with increased risk of overweight and obesity, all-cause mortality, metabolic syndrome, and depression (Lane et al., 2021). There is a large body of evidence to demonstrate healthy eating habits and diets can reduce NCD burden (Dinu et al., 2018; Onvani et al., 2017).

Establishing good nutrition in early childhood is critical for cognitive development (Tandon et al., 2016) and long-term healthy eating behaviours and dietary patterns (Davies et al., 2016). An unhealthy diet in childhood is associated with rapid weight gain (Brands et al., 2014), increased risk of childhood obesity (Zalewski et al., 2017), and increased risk of obesity and cardiovascular disease in adulthood (Kaikkonen et al., 2013). The annual direct costs of childhood overweight and obesity is projected to be $13.52 billion (2022 United States Dollars) by 2050 (Ling et al., 2023). Investing in early childhood nutrition interventions can reduce economic costs from diet related NCDs (Crosland et al., 2019). However, national health surveys show that overall diet quality of pre-school children remains low in high income countries (HIC). In the United States of America (USA), the 2015–16 National

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Health and Nutrition Examination Survey showed that 39.8% of children aged 2–5 years had poor-quality diets (Liu et al., 2020). In Australia, the 2017–18 Australian Health Survey showed that only 18.5% of children aged 2–3 years and 3.8% of children aged 4–8 years were meeting both fruit and vegetable recommendations (Statistics ABo, 2023).

As children reach preschool years, there is a rapid development of self-regulation skills, decreased reliance on parents and caregivers and increased capacity to make individual decisions involved in developing healthy diets (Skouteris et al., 2021). There have been many studies targeting children's diets during this critical developmental period with mixed results. A Cochrane systematic review of 80 interventions for increasing fruit and vegetable intake in children 0–5 years found that the quality of evidence and magnitude of effect remains limited (Hodder et al., 2020). The evidence for the translation of early childhood nutrition interventions into sustainable real-world population level impact remains uncertain (Hodder et al., 2020; Wolfenden et al., 2020; Matwiejczyk et al., 2018). As such, there has been increasing attention for whole system approaches that target the complex, multifactorial determinants influencing nutrition and eating (Bagnall et al., 2019).

The modern food systems in HIC, have an abundance of highly-processed food which promotes excessive energy intake associated with overweight, obesity and NCDs (HLPE, 2017). Food systems consider the interactions between the food supply chain, external and personal food environments, the behaviours of caregivers and children, and children's diets (Raza et al., 2020). A shift in the current food system is needed to address malnutrition and achieve the global nutrition targets as set by the United Nations Sustainable Development Goals (FAO I, UNICEF, WFP, WHO, The State of Food Security and Nutrition in the World, 2021; Swinburn et al., 2019). A systems approach takes into consideration all levels of the food system to support children to achieve healthy and sustainable diets (HLPE, 2017; Raza et al., 2020). However, it remains unclear which determinants in the food system need to be prioritised.

This review aims to systematically map interventions targeting dietary intake in pre-school aged children in HIC. This review will identify food system leverage points and guide the translation of systems approaches into policy and practice to improve early childhood nutrition. A scoping review approach is suitable for synthesising the large breadth of literature on early childhood nutrition and identifying knowledge gaps (Munn et al., 2018).

## 2. Methods

### 2.1. Protocol and registration

The scoping review was conducted following the Joanna Briggs Institute (JBI) Methodology for Scoping Reviews (Aromataris, 2020). The results are reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for the scoping review process (Supplementary File 1). The review protocol was registered with the Open Science Framework on 25 July 2022 and updated on 14 April 2023 to outline changes in reporting of mapping outcomes separately (registration digital object identifier: https://doi.org/10.17605/OSF.IO/KP49E)

### 2.2. Eligibility criteria

The eligibility criteria were determined using the Population, Concept and Context framework as defined by JBI (Aromataris, 2020).

The population of interest were pre-school aged children. Studies were eligible for inclusion if they targeted children aged 2–5 years and/or stakeholders involved in food provision such as parents and caregivers, and early childhood education and care (ECEC) service staff. Children under 2 years were excluded due to different developmental stages and dietary requirements. Studies that only included children with clinical conditions were ineligible.

To be as comprehensive as possible, any study that examined the impact of a nutrition or multicomponent intervention on the dietary intake of pre-school children were eligible. Studies were ineligible if children's dietary intake was not reported.

Eligible studies were limited to those conducted in HIC with modern food systems like Australia. HIC were defined by World Bank classifications (The World Bank, 2023).

Experimental studies using randomised controlled trial (RCT), non-randomised controlled trial, and quasi-experimental study designs and analytical observational studies using cohort, case-control and analytical cross-sectional study designs examining exposure to an intervention were eligible. Qualitative studies, reviews, unpublished manuscripts, conference abstracts, and studies that did not provide new data such as commentaries were ineligible.

### 2.3. Information sources and search strategy

An initial limited scoping search was conducted on SCOPUS and MEDLINE to identify relevant peer-reviewed articles. Keywords in the title, abstract and subject headings were used to develop the search strategy in consultation with an experienced academic liaison librarian.

A full search was conducted across six electronic bibliographic databases (Scopus, Medline via Ovid, Embase via OvidSP, ERIC via OvidSP, Global Health via OvidSP, and The Cochrane Library) on 17 May 2022. The search strategy was adapted for use with each database (Supplementary File 2).

The search was limited to studies published in the English language and from January 2000 up to the date the searches were run. The cut-off date has been chosen to capture key interventions implemented in Australia identified in the initial scoping search.

### 2.4. Selection of sources of evidence

Search results were uploaded into EndNote 20 and de-duplicated (Bramer et al., 2016). Covidence was used for the screening process. Pilot testing of the eligibility criteria was performed on a random sample of 25 studies before commencing screening (Aromataris, 2020). Screening of title and abstracts against the eligibility criteria was performed by one reviewer (JC). Full texts for potentially relevant reports were retrieved and reviewed independently and in duplicate by two reviewers (JC, PC) against the eligibility criteria. Disagreements between screeners were resolved by consensus or by decision of a third researcher (MAF) if consensus was not reached. Reasons for exclusion of full-text reports were recorded against the eligibility criteria.

### 2.5. Data charting process and data items

Data extraction was completed by one reviewer and 20% was cross-checked with a second reviewer using a pilot tested form. The data extracted and summarised included specific details about the article, aims/purpose, participants, methods, intervention, outcomes (as described in Concept section above) and the dietary determinants addressed.

### 2.6. Synthesis of results

The Determinants of Nutrition and Eating (DONE) framework (DONE Universitat Konstanz, 2023) was used to systematically organise determinants addressed in included studies. The DONE framework is an interdisciplinary framework of the factors driving food choice, eating behaviour and dietary intake. It was developed in a three-phase process by 87 members of the European research network, Determinants of Diet and Physical Activity, and 129 external experts (Stok et al., 2017). Determinants were identified and categorised into a framework through three Delphi consensus rounds. The framework was then evaluated, and

determinants were rated on modifiability, relationship strength, and population level effects. In the final phase, a pilot round of framework updating was conducted. The final framework includes 411 determinants, categorised by four main socio-ecological levels (policy, environment, interpersonal and individual), and further sorted by two additional layers including 11 stem-categories and 51 leaf-categories (Stok et al., 2017). The DONE framework provides an overall priority of research (OPR) score for each determinant on a scale of 1.00 (Low) to 3.00 (High), calculated by taking a weighted average of modifiability, relationship strength, and population-level effect scores (Stok et al., 2017).

For the synthesis of our results, studies were categorised by main socio-ecological levels, then stem-categories and leaf-categories. An average OPR score for each leaf category was calculated and assigned a DONE research priority rating of Low (mean OPR = 1.00–1.49), Moderate (mean OPR = 1.50–1.99), Substantial (mean OPR = 2.00–2.49) or High (mean OPR = 2.50–3.00). These categories were previously defined in the development of the DONE framework (Stok et al., 2017).

As the DONE framework was not designed specifically for the early childhood setting, we were unable to categorise the childcare food environment using existing framework determinants. '*Childcare food environment*' was added as an additional determinant for this review. This was categorised under the Environment Food Availability and Accessibility leaf category as part of the Meso/Macro Environment stem category similar to the existing determinant for school-aged children '*School canteen food environment*'. The childcare setting has been previously categorised in the Meso/Macro environment (Swinburn et al., 2019).

## 3. Results

A total of 32,566 records were identified from electronic database searches. After duplicate records were removed, the title and abstract of 21,369 records were screened and 1066 full text reports were retrieved and assessed for eligibility. A final sample of 160 studies met eligibility criteria and were included in the review (Fig. 1). Primary reasons for exclusion were ineligible study design ($n = 309$) and children's dietary intake not reported as an outcome ($n = 287$).

### 3.1. Characteristics of included studies

The largest proportion of studies were conducted in the USA ($n = 93$, 58.1%), followed by Australia ($n = 18$, 11.3%), the United Kingdom ($n = 11$, 6.9%), Canada ($n = 4$, 2.5%), and Portugal (n = 4, 2.5%). There were 91 studies conducted in the ECEC setting ($n = 91$, 56.9%), 24 studies were conducted in the community setting ($n = 25$, 15.6%), 17 studies were home-based ($n = 17$, 10.6%), nine studies were federal programs (n = 9, 5.6%), eight studies were conducted online (Facebook, website or app) or by telephone ($n = 8$, 5%), five studies were conducted in the health care setting ($n = 5$, 3.1%), five studies were conducted

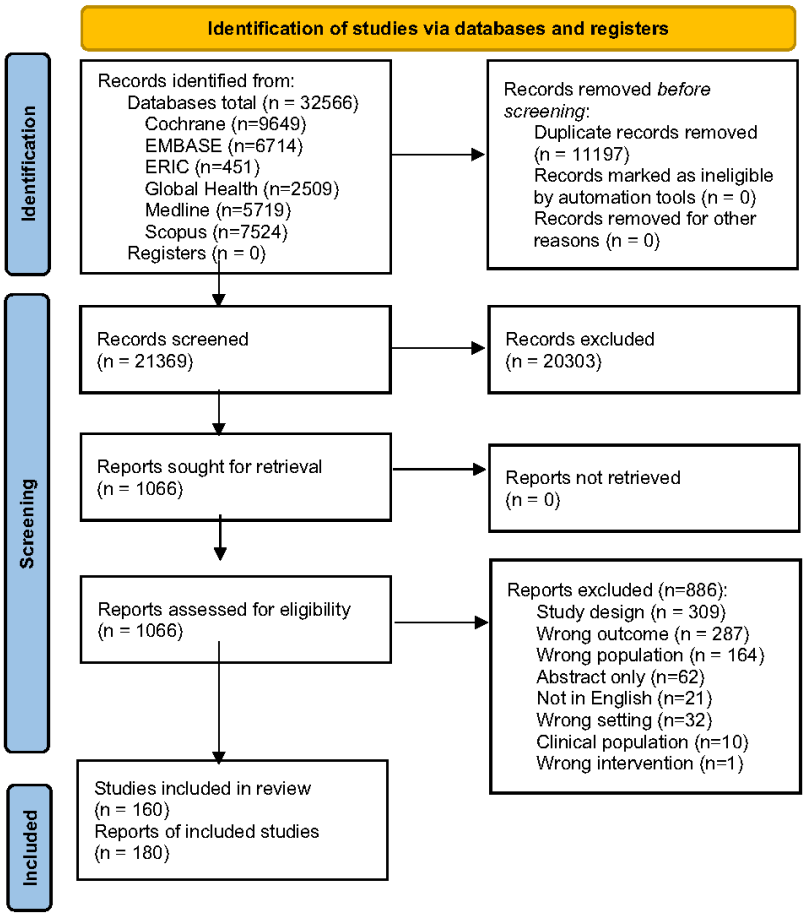


**Fig. 1.** Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) 2020 flow diagram for new systematic reviews which included databases and registers only. The flow diagram has been used as recommended by the PRISMA extension for scoping reviews.

across multiple settings (n = 5, 3.1%), and one study was conducted in the playgroup setting (*n* = 1, 1.6%).

Most studies targeted interpersonal (*n* = 101, 63.1%) and individual (*n* = 85, 53.1%) level determinants, with fewer targeting environmental (*n* = 55, 34.4%) and policy level (*n* = 17, 10.6%) determinants (Fig. 2). Most interventions addressed one socioecological level (*n* = 75, 46.9%) or two levels (*n* = 70, 43.8%). Fewer studies targeted combined individual, interpersonal and environment level strategies (*n* = 13, 8.1%). Only one study (n = 1, 0.6%) included strategies that targeted determinants across all 4 levels. DONE framework categories for each included study is available in Supplementary File 3. A summary of the included studies by DONE framework is presented below.

### 3.2. Individual level

Of the 85 studies that targeted individual level determinants, 59 studies included interventions to address determinants across multiple socio-ecological levels. Most studies addressed psychological category determinants (*n* = 75), followed by biological determinants (*n* = 15) and situational determinants (*n* = 14). No studies addressed demographic category determinants (Table 1).

#### 3.2.1. Biological

All studies that addressed biological determinants included children's sensory perception. Most studies examined associations between repeated exposure strategies and vegetable liking and preference (Johnson et al., 2019; Lanigan et al., 2019; Nekitsing et al., 2019a; O'Connell et al., 2012). Studies also combined repeated exposure with a familiar or liked food (flavour-flavour learning) (Ahern et al., 2014; Anzman-Frasca et al., 2012; Correia et al., 2014; Corsini et al., 2013; De Wild et al., 2015) or reward (Corsini et al., 2013; Braga-Pontes et al., 2022; Fildes et al., 2014). Other interventions examined associations between sensory play (Nekitsing et al., 2019b; Roberts et al., 2022) and offering food in different shapes and liking and wanting of vegetables and healthy snacks (Correia et al., 2014; Boyer et al., 2012).

#### 3.2.2. Demographic

There were no studies that addressed demographic determinants (Table 1).

#### 3.2.3. Psychological

Most studies in the psychological stem category addressed children's Food Knowledge, Skills and Abilities (*n* = 67). Interventions included classroom-based activities with children such as taste testing, games, song, and activity sheets (Johnson et al., 2019; Nekitsing et al., 2019a; Braga-Pontes et al., 2022; Brand et al., 2017; Cason, 2001; Choi et al., 2018; De Coen et al., 2012; De Craemer et al., 2020; Fitzgibbon et al., 2013; Fitzgibbon et al., 2005; Fitzgibbon et al., 2006; Fitzgibbon et al., 2011; Gagné et al., 2013; Grummon et al., 2019; Iaia et al., 2017; Knol et al., 2016; Kong et al., 2016; Korn et al., 2021; Kostecka, 2022; Kunkel et al., 2013; Lee et al., 2017; Ling et al., 2018; Lumeng et al., 2017; Martincrespo-Blanco et al., 2022; McSweeney et al., 2017; Melnick et al., 2020; Munday and Wilson, 2017; Namenek Brouwer and Benjamin Neelon, 2013; Natale et al., 2021; Natale et al., 2014; Poeta et al., 2019; Rito et al., 2018; Schuler et al., 2019; Sharma et al., 2019; Vaughn et al., 2021; Vereecken et al., 2009; Witt and Dunn, 2012; Yeom and Cho, 2019; Yin et al., 2012; Whiteside-Mansell and Swindle, 2019), four studies specifically used storybooks (Nekitsing et al., 2019b; Barnes and Warren, 2017; de Droog et al., 2017; Hong et al., 2018a) and one study involved a puppet show for children (Nicklas et al., 2017). Other strategies included parent and child nutrition education sessions (Ashton et al., 2021; Barkin et al., 2018; Bender et al., 2013; Buscemi et al., 2019; De Bock et al., 2012; Heerman et al., 2019; Hughes et al., 2021; Kim et al., 2019; Kim, 2016; Mobley et al., 2022; Morgan et al., 2021;

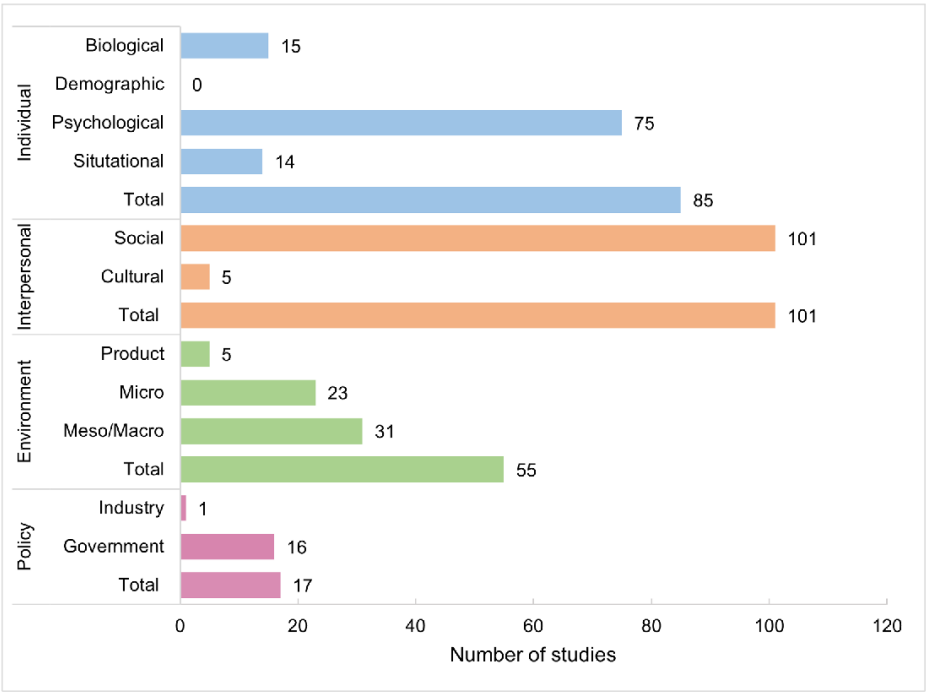


**Fig. 2.** Number of studies (*n* 160) targeting stem level categories and main level socioecological categories (total[1]) of the Determinants of Nutrition and Eating framework.

[1] Total number may not equal sum of stem level and/or main level categories as studies may target multiple stem level categories and across multiple main level categories.

**Table 1**
Number of studies and average Determinants of Nutrition and Eating (DONE) framework research priority score per stem and leaf category at the Individual level.

| Leaf category | Example determinants | Research priority[1] | n (studies) |
|---|---|---|---|
| **Biological** | | | |
| **Food-Related Physiology** | genetic nutrient intolerances, appetite, food allergies, taste sensitivity, obesity-associated genes, gut microbiota | 1.79 | 0 |
| **Anthropometrics** | BMI, body composition, birth weight | 1.61 | 0 |
| **Sensory Perception** | food preferences, taste aversions, food liking, food wanting, fat liking, learned taste preferences, biological taste preferences | 2.11 | 15 |
| **Physical Health** | mental health status, health status, chronic diseases, prematurity | 1.71 | 0 |
| **Sleep Characteristics** | sleep duration, sleep difficulties | 1.55 | 0 |
| **Demographic** | | | |
| **Biological Demographics** | having been breastfed, sex, age | 1.69 | 0 |
| **Cultural Characteristics** | religion, nationality, ethnicity | 1.67 | 0 |
| **Personal Socio-Economic Status** | socio-economic status | 1.64 | 0 |
| **Situational Demographics** | place of residence | 1.82 | 0 |
| **Psychological** | | | |
| **Personality** | self-efficacy, distractibility when eating, personality / temperament | 1.89 | 0 |
| **Mood And Emotions** | wellbeing, positive emotions, negative emotions, mood | 1.78 | 1 |
| **Self-Regulation** | self-regulation skills, self-control, emotion suppression, impulsivity, executive functioning | 1.86 | 3 |
| **Health Cognitions[2]** | previous experience with disease | N/A | 0 |
| **Food Knowledge, Skills and Abilities** | food familiarity, food memories | 1.82 | 67 |
| **Food Habits** | habitual eating, past eating behaviour | 1.92 | 1 |
| **Food Beliefs** | food involvement, food enjoyment, | 2.13 | 30 |
| **Eating Regulation** | external eating, neophobia, food selectivity, emotional eating, variety seeking, intuitive eating | 1.78 | 8 |
| **Weight Control Cognitions and Behaviours** | eating in the absence of hunger, disinhibition | 1.98 | 1 |
| **Situational** | | | |
| **Hunger** | satiation, food deprivation, hunger | 2.22 | 1 |
| **Related health Behaviours** | frequency of television viewing, physical activity level | 2.28 | 13 |
| **Situational And Time Constraints** | daily rhythm/structure, parental access to a car | 1.64 | 0 |

[1] Average DONE OPR scores across the leaf categories (out of 3.00). Low (mean OPR = 1.00-1.49), Moderate (mean OPR = 1.50-1.99), Substantial (mean OPR = 2.00-2.49) or High (mean OPR = 2.50-3.00).

Morris et al., 1752; Pathirana et al., 2018; Ray et al., 2020; Rose et al., 2014; Salazar et al., 2014; Skouteris et al., 2016; Sobko et al., 2020; Steenbock et al., 2019; Williams et al., 2014) and two studies involved family nutrition education sessions via home visits (Taverno Ross et al., 2018; Tomayko et al., 2016).

Interventions from thirty studies were categorised into Food Beliefs. Many studies aimed to influence food belief determinants through food preparation and cooking activities with children and/or parents (Knol et al., 2016; Kostecka, 2022; Lumeng et al., 2017; McSweeney et al., 2017; Melnick et al., 2020; Munday and Wilson, 2017; Poeta et al., 2019; Witt and Dunn, 2012; Yeom and Cho, 2019; Whiteside-Mansell and Swindle, 2019; De Bock et al., 2012; Kim, 2016; Mobley et al., 2022; Pathirana et al., 2018; Rose et al., 2014; Sobko et al., 2020; Williams et al., 2014; Taverno Ross et al., 2018; Kong et al., 2014; Nix et al., 2021; Rohde et al., 2017), taste testing (Johnson et al., 2019; Grummon et al., 2019; Kong et al., 2016; Kostecka, 2022; Lee et al., 2017; McSweeney et al., 2017; Melnick et al., 2020; Munday and Wilson, 2017; Namenek Brouwer and Benjamin Neelon, 2013; Sharma et al., 2019; Vereecken et al., 2009; Witt and Dunn, 2012), and gardening activities (Munday and Wilson, 2017; Sharma et al., 2019; Sobko et al., 2020). Some studies aimed to influence children's thoughts and beliefs about healthy foods using characters and story such as mascots, puppets and role playing (Vaughn et al., 2021; Witt and Dunn, 2012; Whiteside-Mansell and Swindle, 2019; Nicklas et al., 2017).

Fourteen studies addressed Eating Regulation. Interventions investigated repeated exposure and vegetable neophobia (Lanigan et al., 2019; Poeta et al., 2019; Ahern et al., 2019), exposure to a variety of fruits and vegetables (Ahern et al., 2019; Roe et al., 2022), mindful eating activities and group meals (Knol et al., 2016; Hong et al., 2018b) and nutrition education on hunger and fullness cues (Williams et al.,

2014). External cues to encourage consumption of healthy foods included use of nutrition phrases during meal times (Lanigan et al., 2019) and plate design with sections for fruit and vegetables (Melnick et al., 2020).

Of the three studies that addressed Self-Regulation, two pre-school programs promoted self-regulation skills via problem solving and behaviour change activities (Lumeng et al., 2017) and breathing sessions (Ray et al., 2020). One intervention targeted self-regulation, responsive feeding and sensitive parenting via home visit lessons (Nix et al., 2021). One study addressed Mood and Emotions, targeting children's mental wellbeing through classroom modules (Steenbock et al., 2019). One study specifically addressed Food Habits via a nursery health promotion campaign to encourage children to eat vegetables as the first bite of meals (Tani et al., 2021). One study addressed Weight Control Cognitions and Behaviours, examining the impact of gardening program on eating in the absence of hunger among children (Lee et al., 2017).

#### 3.2.4. Situational

Thirteen studies included strategies to address children's physical activity levels and were mapped to the Related Health Behaviours leaf category (Fitzgibbon et al., 2005; Fitzgibbon et al., 2006; Fitzgibbon et al., 2011; Kong et al., 2016; Yin et al., 2012; Ashton et al., 2021; Barkin et al., 2018; Bender et al., 2013; Buscemi et al., 2019; Heerman et al., 2019; Morgan et al., 2021; de Silva-Sanigorski et al., 2010; Fletcher et al., 2013). One study assessed carbohydrate digestion rates on satiety (Alvina and Araya, 2004).

### 3.3. Interpersonal level

Of the 101 interpersonal level studies, 68 were multi-level. All studies ($n$ = 101) addressed social determinants and five studies considered cultural determinants (Table 2).

#### 3.3.1. Social

Most studies addressed social leaf-category determinants related to

**Table 2**
Number of studies and average Determinants of Nutrition and Eating (DONE) framework research priority score per stem and leaf category at the Interpersonal level.

| Leaf category | Example determinants | Research priority[1] | n (studies) |
|---|---|---|---|
| **Social** | | | |
| **Family Structure** | household size, family cohesion, family composition | 1.43 | 1 |
| **Family Food Culture** | family food culture, household food processing (cooking), family preferences, household food production (growing) | 1.89 | 11 |
| **Household Socio-Economic Status** | parental food insecurity, household food security, low parental income parental educational level, household income, household socio-economic status, household budget constraints, parental income, parental occupation | 1.73 | 0 |
| **Social Influence** | peer modelling, eating occasion, social norms | 2.18 | 9 |
| **Social Support** | parental recommendations, social support, community recommendations | 2.12 | 9 |
| **Parental Resources and Risk Factors** | parental nutrition knowledge, parental food market knowledge, parental food product knowledge, parental time constraints, parental depression | 1.99 | 85 |
| **Parental Attitudes and Beliefs** | parental weight control concerns, parental perception of child's weight, parental perceived food safety, parental weight control goal, parental lay food theories, parental trust in food labelling, parental trust in food producers, parental food ethics, parental food risk aversion, parental willingness-to-pay, parental trust in food certification, parental trust in food distribution, parental body dissatisfaction | 1.80 | 25 |
| **Parental Behaviors** | parental modelling, parental food habits parental food processing (cooking), parental lifestyle, parental smart shopping, parental frugality, parental food production (growing) | 2.01 | 52 |
| **Parental Feeding Styles** | early exposure, parental portion size habits, food used as incentive, parental food restriction, parental pressure-to-eat, parental instrumental feeding, parental emotional feeding | 2.15 | 25 |
| **Cultural** | | | |
| **Cultural Cognitions** | cultural beliefs, cultural values, cultural norms | 2.06 | 5 |
| **Cultural Behaviours** | cultural food customs, cultural traditions, religious rituals | 1.92 | 0 |

[1] Average DONE OPR scores across the leaf categories (out of 3.00). Low (mean OPR = 1.00-1.49), Moderate (mean OPR = 1.50-1.99), Substantial (mean OPR = 2.00-2.49) or High (mean OPR = 2.50-3.00).

Parental Resources and Risk Factors ($n$ = 85). Thirty-nine studies investigated in-person nutrition education sessions and parental nutritional knowledge and some included a parental homework component (Fitzgibbon et al., 2013; Knol et al., 2016; Ling et al., 2018; Lumeng et al., 2017; Natale et al., 2021; Natale et al., 2014; Poeta et al., 2019; Yin et al., 2012; Barkin et al., 2018; Bender et al., 2013; Buscemi et al., 2019; De Bock et al., 2012; Heerman et al., 2019; Hughes et al., 2021; Kim, 2016; Mobley et al., 2022; Morgan et al., 2021; Ray et al., 2020; Rose et al., 2014; Salazar et al., 2014; Skouteris et al., 2016; Sobko et al., 2020; Steenbock et al., 2019; Williams et al., 2014; Taverno Ross et al., 2018; Rohde et al., 2017; Condrasky et al., 2006; Doring et al., 2016; Duncanson et al., 2013; Fisher et al., 2019; French et al., 2018; Gomes et al., 2020; Gomes et al., 2018; Kerver et al., 2022; Klohe-Lehman et al., 2007; Nezami et al., 2018; Walton et al., 2015; Willis et al., 2014; Willis et al., 2016). Twelve studies delivered nutrition education via telephone support calls, online modules or sessions, or an app (Au et al., 2016; Brown et al., 2019; Dulin Keita et al., 2014; Hammersley et al., 2019; Knowlden and Conrad, 2018; Krieger et al., 2021; Nyström et al., 2017; Pearson et al., 2022; Sherwood et al., 2015; Small et al., 2012; Tabak et al., 2012; Wolfenden et al., 2014). Twenty-three studies aimed to improve parental nutrition knowledge through provision of parent communication resources including written information on handouts, newsletters, flyers, posters, tip cards, health reports, resource folder, backpack, and through compact disks (Brand et al., 2017; De Coen et al., 2012; De Craemer et al., 2020; Fitzgibbon et al., 2005; Fitzgibbon et al., 2006; Fitzgibbon et al., 2011; Grummon et al., 2019; Kong et al., 2016; Kunkel et al., 2013; Lee et al., 2017; Martincrespo-Blanco et al., 2022; McSweeney et al., 2017; Sharma et al., 2019; Vereecken et al., 2009; Yeom and Cho, 2019; Whiteside-Mansell and Swindle, 2019; Hong et al., 2018a; Nicklas et al., 2017; Byrd-Bredbenner et al., 2018; Davison et al., 2013; Hunsaker and Jensen, 2017; Kristiansen et al., 2019; Woodward-Lopez et al., 2018). Four studies delivered information via text messaging, Facebook or website only (Ling et al., 2018; Brown et al., 2019; Bakırcı-Taylor et al., 2019; Zhang et al., 2021). Five studies provided clinic-based brief parental intervention (Iaia et al., 2017; French et al., 2018; Beck et al., 2017; Cloutier et al., 2015; Schwartz et al., 2007) and three studies delivered education via home-visits (Lumeng et al., 2017; Tomayko et al., 2016; Haire-Joshu et al., 2008). One program assessed the effect of a nutrition education program for pre-school children on parental nutrition knowledge (Kostecka, 2022).

Parental Behaviour was addressed in 52 studies. Frequently used strategies included home based tasks or home visits involving goal setting, feedback and self-monitoring of behaviour (Grummon et al., 2019; Knol et al., 2016; Lumeng et al., 2017; Natale et al., 2014; Vaughn et al., 2021; Ashton et al., 2021; Morgan et al., 2021; Ray et al., 2020; Sobko et al., 2020; Taverno Ross et al., 2018; Tomayko et al., 2016; Klohe-Lehman et al., 2007; Willis et al., 2014; Willis et al., 2016; Nyström et al., 2017; Hunsaker and Jensen, 2017; Haire-Joshu et al., 2008; McGowan et al., 2013; Mirotta et al., 2018), skill-building workshops (Ling et al., 2018; Natale et al., 2021; Poeta et al., 2019; Barkin et al., 2018; De Bock et al., 2012; Mobley et al., 2022; Morgan et al., 2021; Rose et al., 2014; Fisher et al., 2019; French et al., 2018; Walton et al., 2015; Willis et al., 2014; Willis et al., 2016; Au et al., 2016; Knowlden and Conrad, 2018; Marsh et al., 2020; Sobko et al., 2017), cooking classes (Brand et al., 2017; Lumeng et al., 2017; De Bock et al., 2012; Kim, 2016; Pathirana et al., 2018; Rose et al., 2014; Condrasky et al., 2006; Kerver et al., 2022; Kristiansen et al., 2019), and nutrition counselling and motivational interviewing (Iaia et al., 2017; Heerman et al., 2019; Doring et al., 2016; Dulin Keita et al., 2014; Hammersley et al., 2019; Sherwood et al., 2015; Wolfenden et al., 2014; Davison et al., 2013; Mirotta et al., 2018; Hammersley et al., 2021). Other strategies included written materials such as handouts or facebook posts (Vaughn et al., 2021; Krieger et al., 2021; Byrd-Bredbenner et al., 2018; Zhang et al., 2021) and community activities (Bender et al., 2013).

Parental Feeding Styles determinants were addressed by 25 studies. Interventions included group education sessions (Knol et al., 2016; Hughes et al., 2021; Kim, 2016; Mobley et al., 2022; Morgan et al., 2021; Sobko et al., 2020; Fisher et al., 2019; Gomes et al., 2020; Gomes et al., 2018; Walton et al., 2015; Willis et al., 2014; Willis et al., 2016; Knowlden and Conrad, 2018; Marsh et al., 2020), home based activities such as home visits, telephone calls, goal setting, and written materials (Corsini et al., 2013; Fildes et al., 2014; Nix et al., 2021; Dulin Keita et al., 2014; Small et al., 2012; Wolfenden et al., 2014; Byrd-Bredbenner et al., 2018; Haire-Joshu et al., 2008) and online support via Facebook groups (Ling et al., 2018; Hammersley et al., 2019; Kristiansen et al., 2019).

Parental Attitudes and Beliefs determinants were addressed by 25 studies. Interventions included group education and homework activities (Fitzgibbon et al., 2013; Natale et al., 2014; Poeta et al., 2019; Morgan et al., 2021; Rose et al., 2014; Gomes et al., 2020; Gomes et al., 2018; Klohe-Lehman et al., 2007), posters (Walton et al., 2015; Davison et al., 2013), and nutrition counselling, goal setting and provision of health reports (Morgan et al., 2021; Doring et al., 2016; Klohe-Lehman et al., 2007; Nezami et al., 2018; Sherwood et al., 2015; Tabak et al., 2012; Byrd-Bredbenner et al., 2018; Davison et al., 2013; Cloutier et al., 2015; Schwartz et al., 2007; Mirotta et al., 2018).

Family Food Culture determinants were addressed by 11 studies. All intervention included food preparation and cooking, or family activities such as group dinners, and handouts with cooking or gardening instructions (Munday and Wilson, 2017; Bender et al., 2013; Mobley et al., 2022; Rose et al., 2014; Sobko et al., 2020; Taverno Ross et al., 2018; Nix et al., 2021; Rohde et al., 2017; Kerver et al., 2022; Dulin Keita et al., 2014; Byrd-Bredbenner et al., 2018).

Social Support determinants were addressed by nine studies. Diet and eating related support at the community level was embedded in interventions through referrals to community resources (Taverno Ross et al., 2018; French et al., 2018) and community health promotion social marketing campaigns (Korn et al., 2021; Tani et al., 2021; de Silva-Sanigorski et al., 2010). Parental social support was provided through Facebook groups and in-person meetings for parents to discuss and share experiences (Ling et al., 2018; Morgan et al., 2021; Hammersley et al., 2019; Hammersley et al., 2021).

Social Influence determinants were addressed by eight studies. Four studies included ECEC service staff role modelling as a strategy (Namenek Brouwer and Benjamin Neelon, 2013; Natale et al., 2021; Vereecken et al., 2009; Yin et al., 2012; Kristiansen et al., 2019). Two studies used videos, storybooks or puppets to role model target behaviours (Vereecken et al., 2009; Horne et al., 2011). Other interventions included videos of other pre-school children eating (Staiano et al., 2016) and cooking and eating meals together in groups of children, teachers and parents (De Bock et al., 2012).

One study addressed Family Structure examining the impact of program to promote parent-child interactions and connectedness to support cohesion, healthy diet and lifestyle behaviours (Marsh et al., 2020). No studies addressed Household Socio-Economic Status.

#### 3.3.2. Cultural

Five studies addressed Cultural Cognitions. All involved culturally tailored programs (Fitzgibbon et al., 2013; Natale et al., 2014; Yin et al., 2012; Bender et al., 2013; Tomayko et al., 2016) and three were delivered by cultural health educators (Fitzgibbon et al., 2013; Natale et al., 2014; Bender et al., 2013). No studies addressed Cultural Behaviour.

### 3.4. Environment level

Of the 54 environmental level studies, 40 were multilevel studies, 31 studies targeted the *meso*/macro environment, 23 studies targeted the micro-environment and five studies addressed product attributes (Table 3).

#### 3.4.1. Product

Of the five studies in this stem category, all addressed Intrinsic

**Table 3**
Number of studies and average Determinants of Nutrition and Eating (DONE) framework research priority score per stem and leaf category at the Environmental level.

| Leaf category | Example determinants | Research priority[1] | n (studies) |
|---|---|---|---|
| **Product** | | | |
| Intrinsic Product Attributes | product taste, product texture, product sensory properties, product flavour | 2.13 | 5 |
| Extrinsic Product Attributes | product package size, package size, product appearance, package colour, product variety, product packaging, food labelling | 2.23 | 0 |
| **Micro** | | | |
| Portion Size | portion size | 2.41 | 3 |
| Home Food Availability and Accessibility | food accessibility, food availability | 2.64 | 15 |
| Eating Environment | meal environment | 2.21 | 5 |
| **Meso/Macro** | | | |
| Natural Conditions | time of day, season, weather | 1.49 | 0 |
| Characteristics Of Living Area | area deprivation, degree of urbanization | 1.58 | 0 |
| Environment Food Availability and Accessibility | ECEC food environment | N/A | 31 |
| Societal Initiatives | food-related NGO activity | 1.67 | 1 |

[1] Average DONE OPR scores across the leaf categories (out of 3.00). Low (mean OPR = 1.00-1.49), Moderate (mean OPR = 1.50-1.99), Substantial (mean OPR = 2.00-2.49) or High (mean OPR = 2.50-3.00).

Product Attributes. Studies aimed to reduce energy density of foods through increasing proportion of fruit and vegetables in meals and snacks served (Leahy et al., 2008a; Leahy et al., 2008b; Reale et al., 2018; Spill et al., 2011) and replacing meals with soy-enhanced lunches (Endres et al., 2003). No studies addressed Extrinsic Product Attributes.

#### 3.4.2. Micro

Within the micro-environment, most studies addressed determinants related to Home Food Availability and Accessibility ($n = 15$). There were eight studies investigating the United States Department of Agriculture Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and home availability and accessibility of healthy foods (Kong et al., 2014; Chiasson et al., 2013; Dundas and Cook, 2004; Guthrie et al., 2020; Meiqari et al., 2015; Odoms-Young et al., 2014; Tester et al., 2016; Zimmer and Vernarelli, 2019). The WIC program provides healthy food packages, information on healthy eating and breastfeeding, and referrals to health care and social services for eligible low-income households (Zimmer and Vernarelli, 2019). Other interventions included online websites and/or telephone calls with health professionals (Wolfenden et al., 2014; Bakırcı-Taylor et al., 2019), farmers market coupons (Stallings et al., 2016) and combination of family activities, provision of resources/equipment and newsletters aimed at improving home food availability and accessibility (Ray et al., 2020; Kerver et al., 2022; Kristiansen et al., 2019; Haire-Joshu et al., 2008).

The eating environment was addressed in five studies. Two studies encouraged or incentivised parents to implement behaviour changes (Grummon et al., 2019; Byrd-Bredbenner et al., 2018). Other strategies included home visits (French et al., 2018), motivational interviewing calls (Dulin Keita et al., 2014) and resources such as newsletters, tip cards, posters (De Craemer et al., 2020).

Of the three studies addressing Portion Size, two were conducted in the pre-school setting (Roe et al., 2022; Savage et al., 2012) and one study was conducted in the home setting (Reale et al., 2018), examining the effects of increasing portion size of fruit and vegetables on consumption and energy intake.

#### 3.4.3. Meso/Macro

All Meso/Macro category studies targeted Environment Food Availability and Accessibility ($n = 31$) and were conducted in the childcare setting (Brand et al., 2017; De Coen et al., 2012; De Craemer et al., 2020; Gagné et al., 2013; Grummon et al., 2019; Korn et al., 2021; Munday and Wilson, 2017; Namenek Brouwer and Benjamin Neelon, 2013; Natale et al., 2021; Natale et al., 2014; Schuler et al., 2019; Vereecken et al., 2009; Steenbock et al., 2019; Williams et al., 2014; de Silva-Sanigorski et al., 2010; Kristiansen et al., 2019; Woodward-Lopez et al., 2018; Andreyeva et al., 2018; Bell et al., 2015; Esquivel et al., 2016; Gans et al., 2022; Jones et al., 2015; Kenney et al., 2020; Korenman et al., 2013; Leis et al., 2020; Seward et al., 2018; Ward et al., 2020; Yoong et al., 2019; Yoong et al., 2020; Zaltz et al., 2020; Zask et al., 2012). Interventions included modification of centre menus, development of nutrition policies, support to enhance implementation of best practice, centre staff training, implementation of gardens, and provision of kitchen equipment. One study addressed Social Initiative determinants through increasing organisational capacity of non-government organisations (NGOs) (de Silva-Sanigorski et al., 2010).

### 3.5. Policy level

Of the 17 policy studies, 16 were multi-level studies. Majority of these studies addressed Government determinants ($n = 16$). Only one study addressed Industry determinants (Table 4).

#### 3.5.1. Government

Studies addressing Government Regulation were primarily from USA federal programs that provide subsidies for healthy food aimed to improve food insecurity in low-income households ($n = 14$). Nine studies investigated the United States Department of Agriculture WIC program and children's dietary intake (Kong et al., 2014; Chiasson et al., 2013; Dundas and Cook, 2004; Guthrie et al., 2020; Meiqari et al., 2015; Odoms-Young et al., 2014; Tester et al., 2016; Zimmer and Vernarelli, 2019; Stallings et al., 2016). Three studies examined the Child and Adult Care Food Program (CACFP), a federal USA program that provides reimbursements for meals and snacks for children from low-income households enrolled in childcare centres (Andreyeva et al., 2018;

**Table 4**
Number of studies and average Determinants of Nutrition and Eating (DONE) framework research priority score per stem and leaf category at the Policy level.

| Leaf category | Example determinants | Research priority[1] | n (studies) |
|---|---|---|---|
| **Industry** | | | |
| Industry Regulations | portion size regulations, food nutritional composition regulations, nutritional composition guidelines | 2.18 | 0 |
| Industry Influence | lobbying | 2.04 | 1 |
| **Government** | | | |
| Governmental Regulations | food advertisement regulations, subsidies for healthy foods, nutrition labeling regulations, market regulations, food label regulations food advertisement bans | 2.03 | 14 |
| Campaigns | programs promoting healthy eating, programs discouraging unhealthy eating, educational campaigns for healthy food | 2.18 | 2 |

[1] Average DONE OPR scores across the leaf categories (out of 3.00). Low (mean OPR = 1.00-1.49), Moderate (mean OPR = 1.50-1.99), Substantial (mean OPR = 2.00-2.49) or High (mean OPR = 2.50-3.00).

Kenney et al., 2020; Koreman et al., 2013). Other Government Regulation determinants addressed include dietary guidelines in ECECs in South Carolina (Zaltz et al., 2020) and food advertisement regulations in Chile (Jensen et al., 2021).

Of the two studies that addressed Government Campaign determinants, one study assessed an educational social marketing campaign for healthy food conducted in the United Kingdom (Richards et al., 2009) and one study assessed the efficacy of a nutrition award scheme program promoting healthy eating conducted in long day care centres in Australia (Bell et al., 2015).

#### 3.5.2. *Industry*

Only one study addressed Industry Influence. This study examined lobbying action in a multilevel community trial in the USA-Affiliated Pacific region aiming to reduce sugar-sweetened beverages and increase water intake (Korn et al., 2021). No studies addressed Industry Regulations.

### 3.6. *Research priorities*

Studies most frequently targeted determinants of "Moderate" research priority, which were addressed 203 times, and determinants of "Substantial" research priority which were addressed 189 times (Fig. 3). 'Substantial' determinants that were addressed by less than 10 studies included Hunger (Individual), Social Influence (Interpersonal), Social Support (Interpersonal), Cultural Cognitions (Interpersonal), Intrinsic Product Attributes (Environment), Extrinsic Product Attributes (Environment), Portion Size (Environment), Eating Environment (Environment), Industry Regulations (Policy), Industry Influence (Policy), and Government Campaigns (Policy). Home Food Availability and Accessibility was the only determinant with an average OPR rating of "High" and was addressed by 15 studies. Determinants of "Low" research priority were addressed once.

## 4. Discussion

This review systematically mapped the evidence on early childhood nutrition interventions using the comprehensive DONE framework to understand the extent to which determinants across multiple levels of the food system are being addressed. There was a paucity of multilevel studies, with most studies addressing only one or two socio-ecological levels. Most of the included studies focused on interventions targeting individual and interpersonal level determinants. Fewer studies focused on environment and policy level determinants, despite mostly 'Substantial' to 'High' research priority ratings of these determinants.

At the individual and interpersonal level, child and parental nutrition knowledge and skills were most frequently addressed, which had a 'Moderate' research priority rating. In addition to targeting knowledge and skills, future research addressing more 'Substantial' determinants including children's sensory perceptions, children's food beliefs, parental behaviours and feeding styles, and social influence and support is warranted. Individual and interpersonal determinants have been considered as more modifiable and feasible to implement compared to interventions targeting broader system determinants (Booth et al., 2001). As such, they are often the focus of early childhood nutrition interventions (Jarman et al., 2022; Laws et al., 2022). However, the efficacy of these interventions may be limited without cohesive action across multiple levels to support behaviour change in parents and children (Hawkes et al., 2020). Factors influencing children's eating behaviours are interconnected and involve a range of stakeholders, settings and sectors. Evidence suggests multicomponent interventions such as combining parent education with changes in ECEC policy, were more likely to increase fruit and vegetable consumption in children under 5 years of age (Hodder et al., 2020).

Further environment and policy action is needed to ensure the success of sustained behaviour change interventions (Downs and Demmler, 2020; Kracht et al., 2023). While there have been evidence-based recommendations for systems approaches for nutrition and obesity interventions over the past two decades (Booth et al., 2001), this review identified determinants at the environment and policy level remain understudied. Key priorities include intrinsic and extrinsic food product attributes, portion size, children's eating environment, both industry and government regulation and influence. Home food availability and accessibility was also identified as a critical but understudied determinant and provides a potential leverage point for future interventions to improve children's dietary intake. Studies have shown home availability of healthy foods is associated with increased fruit and vegetable intake in children (Scaglioni et al., 2018). Addressing home food availability and accessibility may be particularly beneficial for low socioeconomic households where ability to purchase healthy foods is limited by income (Downs and Demmler, 2020). Evidence shows that children with parents who were socially disadvantaged were more likely to be affected by overweight or obesity in mid-adolescence (Zhu et al., 2023).

The childcare food environment also plays a critical role in establishing children's eating behaviours and diets and requires further exploration. While there was no DONE research priority rating for this determinant, evidence suggests that this is an important setting for children. Centre-based childcare services provide extensive reach to young children and provide up to 67% of the daily recommended intake, making this setting a valuable intervention target for promotion of

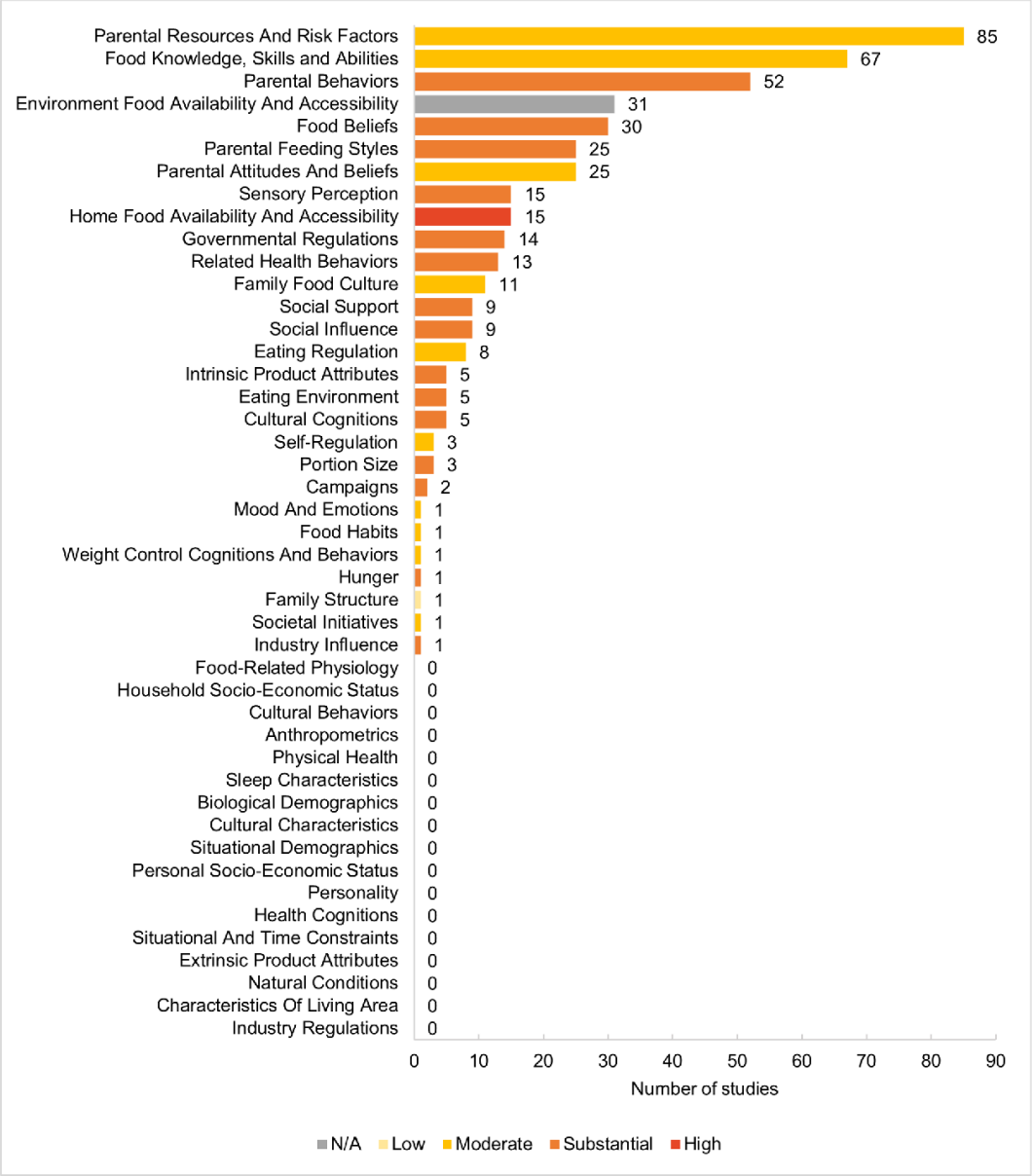


**Fig. 3.** Number of studies targeting Determinants of Nutrition and Eating (DONE) framework leaf categories and classified by average Overall Priority Research (OPR) ratings. OPR ratings for each leaf category were averaged and classified into low (mean OPR 1.00–1.49), moderate (mean OPR 1.50–1.99), substantial (mean OPR 2.00–2.49) and high (mean OPR 2.50–3.00) research priority categories. Mean OPR rating for *Environment Food Availability and Accessibility* was not available due to the additional *"Childcare food environment"* factor included in this study by authors. Leaf categories with no studies were classified in the following OPR categories: Substantial (Extrinsic Product Attributes, Industry Regulations), Moderate (Food-Related Physiology, Household Socio-Economic Status, Cultural Behaviours, Anthropometrics, Physical Health, Sleep Characteristics, Biological Demographics, Cultural Characteristics, Situational Demographics, Personal Socio-Economic Status, Personality, Situational and Time Constraints, Characteristics of Living Area), Low (Natural Conditions). No OPR rating was available from the DONE framework for Health Cognitions.

healthy eating (Robson et al., 2015). Systematic reviews demonstrate that interventions promoting healthy eating in the childcare setting can improve children's dietary intake and food choices (Matwiejczyk et al., 2018). However, sustained implementation of nutrition interventions in this setting is complex, influenced by a number of factors and stakeholders, and remains a challenge (Shoesmith et al., 2021). Further research to understand the determinants in the childcare food environment is recommended.

In addition to addressing children's food environment, there needs to be complementary policies and partnerships with sectors beyond the health domain to support the success of public health strategies. At the policy level, there was some government action, primarily through subsidies for healthy foods in the USA. However, higher level legislative regulations and actions were lacking, notably in relation to industry

influence and regulations. A study mapping healthy eating and active living policy implementation in New South Wales, Australia revealed that while there has been implementation of setting specific policies and programs in ECECs and schools, there was insufficient commitment for action targeting the wider food environment (Esdaile et al., 2023).

There are several barriers to policy level and food system changes to support healthy diets for children. Swinburn et al. argues that industry opposition, insufficient public demand, and government reluctance to translate policy recommendations into action has limited the success of food system shifts (Swinburn et al., 2019). Government and policy level changes are highly contested and challenging. Thus, the health sector reverts to supporting families to make informed choices rather than environmental and policy changes. Limiting factors include culture, ownership, and limited collaborative infrastructure across social, healthcare, and political systems to support changes in the food system (Esdaile et al., 2023). Furthermore, evidence for environmental and policy changes may be limited due to inadequate measures to capture the associations between food environments and health outcomes (Sacks et al., 2019).

### 4.1. Strengths and limitations

A strength of this review is the broad "birds eye view" provided by the scoping review methodology (Munn et al., 2018). This bigger picture approach is critical when looking at food systems to understand the intervention action across multiple levels and domains. The scoping review aimed to capture all published interventions inclusive of experimental and observational analytic studies, however, due to the large number of studies identified the search was limited to peer-review literature and did not include grey literature. A limitation is that study designs other than RCTs may be subject to confounding and raise questions about the robustness of results.

A further limitation of the literature and traditional analysis methods means that while there were more environmental and policy level interventions identified from the search, these studies were excluded as they did not directly measure effect on children's dietary intake.

Another strength of the review is that it systematically synthesised the literature using the comprehensive DONE framework evaluated by experts across multiple fields. The DONE framework helped to summarise the large breadth of evidence in early childhood nutrition and map priorities for future research. A strength of the DONE framework is that it was designed to be dynamic and allow for the addition of new determinants and ratings as understanding changes. In the third phase of the framework development, a pilot round of framework updating was conducted and resulted in the addition of nine new determinants (Stok et al., 2017). Recent studies indicate that environment and policy determinants such as food availability and accessibility continue to be critical drivers (Hodder et al., 2020; Laws et al., 2022; Downs and Demmler, 2020), which has not changed since the DONE framework was last updated in 2017.

However, a limitation of using a novel and dynamic framework is that it may not capture all determinants. The framework may oversimplify the many variables affecting nutrition and may not capture the nuances that may exist in different settings due to environmental influences. For example, the applicability of the DONE framework and research priority ratings in the early childhood setting needs further evaluation. As highlighted by this review, determinants related to the early childhood education and care setting could not be adequately categorised using existing framework categories and we added a category to overcome this. Continued updates are needed to ensure the framework reflects the most recent evidence in nutrition and eating research. For future interventions, we recommend conducting formative research to understand how environmental factors influence which determinants need to be prioritised in each setting.

## 5. Conclusion

To improve the success of early childhood nutrition interventions, a systems approach involving a set of complementary interventions targeting multiple determinants across all socioecological domains is needed. Most interventions target only one or two socioecological domains. Individual and interpersonal level determinants were most frequently addressed in the literature and interventions targeting environmental and policy level determinants were understudied. Environmental and policy changes are needed to support the implementation behaviour change strategies aimed at children and parents and sustain improved dietary outcomes. Findings from this review suggest strategies to improve home food availability and accessibility as part of a set of multilevel actions could improve the success of early childhood nutrition interventions.

## Disclosure of ethical compliance

This scoping review was based on published studies publicly available for access and use, and thus exempt from ethical compliance.

## Disclosure of funding and conflicts of interest

The authors have no possible, perceived, or real financial conflicts of interest or partnership with commercial interests to disclose.

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## Author contributions

JC, PP, DR and MAF were involved in the conceptualisation and design of the study. JC led the data collection and analysis. JC and PC screened articles and extracted data, with assistance from MAF to resolve uncertainties. JC drafted the manuscript, and all authors were involved in review and editing of the final manuscript.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

No data was used for the research described in the article.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2023.107727.

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**Appendix 3.2** Publication resulting from Chapter Three

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REVIEW

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# From preschool to policy: A scoping review of recommended interventions for a systems approach to improve dietary intake in early childhood

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## Summary

Early childhood is a key opportunity to establish healthy eating behaviors and prevent future non-communicable diseases associated with poor diets. How to effectively intervene in the system of the many determinants influencing children's dietary intake remains unclear. This scoping review aimed to map the determinants of nutrition and eating that have been addressed in early childhood nutrition interventions and identify which of these improve dietary intake. We searched six electronic databases to identify eligible studies published from January 2000 to January 2024. We included studies of any interventions reporting dietary intake among children aged between two and five years. A total of 193 eligible studies were identified and mapped to the Determinants of Nutrition and Eating (DONE) Framework. Parent ($n = 97$) and child ($n = 76$) food knowledge and skills were most frequently addressed. Most studies addressing parent (67%) and child (66%) food knowledge and skills reported improvements in dietary intake. Government regulations such as healthy food subsidies, and food advertising and labeling interventions showed promised, with 82% of studies reporting improvements in dietary intake. However, these interventions were predominantly implemented in the United States and Chile. This review provides a comprehensive and systematic map of a range of interventions that positively influence nutritional outcomes in preschool-aged children but recommends further policy-level action globally.

KEYWORDS
children, food systems, nutrition, toddler

## 1 | INTRODUCTION

Sub-optimal diets and high body-mass index (BMI) are among the leading modifiable risk factors for attributable deaths and years of healthy life lost due to premature mortality or disability.[1] Despite efforts worldwide, no country has reversed increases in obesity levels and sub-optimal diets continue to threaten public health progress.[2] The number of children and adolescents living with obesity has increased globally over the past 40 years and is predicted to continue to rise, reaching 254 million by 2030.[3–5] As rates of childhood obesity continue to rise, the projected worldwide economic burden is estimated to cost the healthcare system $13.62 billion and

$49.02 billion in direct and indirect annual costs respectively by 2050.[6]

Improving the quality of children's diets plays a pivotal role in preventing the rising obesity within healthy populations. This not only helps reduce the economic burden, but high-quality diets are also associated with positive outcomes for children, including improved IQ, reduced risk of metabolic syndrome, lower blood pressure, and HbA1c levels, and an overall improvement in mental health-related quality of life.[7] Particularly, the first 2000 days of a child's life from conception to 5 years has been proposed to be a critical window of opportunity where children are experiencing rapid growth and developing lifelong skills and habits..[8] However, most children in high-income countries consume insufficient fruit and vegetables and overconsume sugar-sweetened beverages (SSB).[9] In the United States, an analysis of the National Health and Nutrition Examination Survey 2015–2016 estimated that 40% of children aged 2–5 years have poor quality diets, which was defined as less than 40% adherence to the American Heart Association 2020 continuous diet score.[10] Similarly, in Australia, children are not meeting national dietary guidelines with less than 5% of children meeting recommendations for vegetables, and 39% of their daily energy intake comes from energy-dense nutrient-poor foods high in added sugar, fat, and salt.[11,12]

It has been proposed that the shift in dietary patterns and increase in obesity rates has been largely driven by the contemporary transformation of the food system.[13] The industrialization of food production, technological advances in food processing, and globalization of food distribution have resulted in a food system that prioritizes highly processed, marketed, and affordable foods.[14]

Children's diets are influenced by a multitude of interacting determinants with the food system, making it challenging to implement effective interventions.[15] During the first 2000 days, children are dependent on parents and caregivers to provide adequate nutrition and make choices about food and eating and thus they play key roles in shaping children's diets and exposure to determinants of obesity.[16] Additionally, families are influenced by broader socioecological determinants which encompasses social, cultural, and environmental determinants,[8] such as home, school, community, and digital food environments, as well as the policies that impact and regulate them[17,18].

Effective long-term interventions are needed to support children to achieve high-quality diets, however, what works in real-world settings remains unclear.[19,20] If population-based strategies are to improve and sustain children's diets, a systems-based approach is necessary.[21] Most published reviews have synthesized the evidence specific to a setting or nutrition outcome, however, few reviews have synthesized studies across all socioecological levels to provide a complete overview of the influence of determinants on children's diets. Previous reviews that have taken a systems approach have quantified the number of studies addressing determinants to identify areas most frequently addressed but did not report study outcomes.[22,23] Other reviews have mapped studies according to the socio-ecological model to identify the influence of determinants across individual, interpersonal, environmental, and policy levels[24] or have mapped systematic reviews using the Innocenti Framework to identify which intervention types were effective.[25] To inform priority areas for intervention it is important to identify which determinants have been understudied as well as the expected impact of addressing the determinant on children's dietary intake.

This review aims to add to this body of knowledge by scoping the evidence and providing an in-depth map of which determinants improve dietary intake responding to intervention. The review will also determine successful intervention strategies. The review will pinpoint gaps and identify where more evidence is needed in the context of the food system to design effective solutions to improve children's dietary intake. A scoping review was used to explore and map the breadth of evidence to provide a comprehensive overview of the food system that encompasses the wider determinants of nutrition and eating.[26]

## 2 | METHODS

This scoping review was conducted following the guidelines and methodology recommended by the JBI Manual for Evidence Synthesis and PRISMA extension for Scoping Reviews (Table S1).[26,27]

### 2.1 | Protocol and registration

The a-priori protocol for the review was registered on Open Science Framework (registration digital object identifier: https://doi.org/10.17605/OSF.IO/KP49E) on 25 July 2022. Due to the extensive number of studies identified from the search, the protocol was updated on 14 April 2023 to outline changes in reporting outcomes. The methods were previously reported in a separate study mapping the domains of intervention but are reiterated here for completeness and comprehension.[22]

### 2.2 | Eligibility criteria

Studies that began or targeted children aged between two to five years (up to but not including 6 years) were eligible. Children less than two years were not included due to their different nutritional needs and feeding and eating behaviors. As children's diets are influenced by individual, interpersonal, environmental, and policy factors, interventions targeting key stakeholders at each level including parents, carers, and early childhood education and care (ECEC) service staff were also eligible. Studies targeting children with clinical conditions were not eligible as they may require different dietary requirements and feeding practices. We considered any healthy eating interventions designed to improve children's dietary intake. Measures of dietary intake considered for inclusion are outlined in the core outcome set for early childhood obesity prevention intervention studies developed by Brown et al.[28] Multi-component interventions were included if dietary intake outcomes were reported separately. This ensured that the

review would be comprehensive and capture all published interventions. Eligible studies were conducted in high-income countries to capture the context of modern food systems, characterized by an abundance of highly-processed food that promotes excessive energy intake.[29] Eligible primary research study designs included experimental, quasi-experimental and analytical observational studies such as repeated cross-sectional surveys that reported exposure to intervention and outcome. Studies were eligible if they were published after January 2000 in the English language.

### 2.3 | Information sources

The search was conducted across six electronic databases including Embase via Ovid (1947 to present), ERIC via Ovid (1966 to present), Global Health via Ovid (1910 to present), MEDLINE via Ovid (1946 to present), Scopus (1996 to present), and The Cochrane Library (Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials [CENTRAL], Cochrane Methodology Register). Additionally, a search of the reference lists of relevant systematic reviews, meta-analyses, and umbrella reviews was conducted for eligible studies missed by our search. The original search was performed in May 2022 and updated in January 2024 using methods described by Bramer & Bain.[30]

### 2.4 | Search

The search strategy was designed with an experienced academic librarian. The full electronic search strategy for Medline via Ovid database is provided in Table S2.

### 2.5 | Selection of sources of evidence

Records identified from the search were de-duplicated using methods described by Bramer et al managed in Endnote X20.[31] Selection was performed using the pre-specified eligibility criteria in the protocol. To calibrate and refine definitions of eligibility criteria, one author (J.C.) pilot tested the eligibility criteria using a random sample of 25 records. One author (J.C.) screened titles and abstracts of all studies for eligibility using Covidence software. Full-text records were retrieved for potentially relevant studies and reviewed by two authors (J.C. and P.C.) independently in Covidence. Conflicts were resolved by consensus or decision of a third author (M.A.F.) not involved in the selection process when consensus could not be reached.

### 2.6 | Data charting process

The JBI template data charting instrument for scoping reviews and umbrella reviews was adapted for this review.[26] One author (J.C.) extracted all data using the pre-specified data charting form and a second author (P.C.) independently extracted 20% of the data for verification in Covidence.

### 2.7 | Data items

The data extracted included study characteristics (first author, publication year, country, study design, study aim), inclusion/exclusion criteria, participants (sample size, age, ethnicity, socioeconomic status), intervention characteristics (description, comparator, duration, intensity), and outcomes and measures (data collection methods, outcome measures) and findings relating to children's dietary intake.

### 2.8 | Synthesis of results

The determinants addressed by interventions were systematically categorized using the Determinants of Nutrition and Eating (DONE) framework, which was developed by the Determinants of Diet and Physical Activity European research network of 87 members and 129 external experts.[32] The framework maps 411 factors driving nutrition and eating behavior into 56 determinant leaf categories, 11 stem categories, and four socioecological levels (individual, interpersonal, environment, and policy). Determinants related to the childcare food environment were not categorized by the DONE framework, so the existing 'School canteen food environment' determinant was modified to 'Childcare food environment' to capture this.

Studies were categorized by main socio-ecological levels, followed by stem and leaf categories, using extracted data related to intervention characteristics and outcome measures. One author (J.C.) synthesized all studies to the DONE Framework and a second author (P.C.) cross-checked 20% of included studies.

The intervention characteristics, determinants addressed by interventions, and outcomes were summarized in narrative form. Findings were organized and presented following the DONE framework stem categories: biological, demographic, psychological, and situational determinants at the individual level; social and cultural determinants at the interpersonal level; product, micro, meso/macro determinants at the environment level; and industry and government determinants at the policy level. The number of studies that reported improved outcome measures of diet quality, fruit, vegetable, combined fruit and vegetable, energy-dense nutrient-poor foods, or SSB intake, as outlined in the core outcome set,[28] were tabulated against DONE stem categories (Table 2) and leaf categories (Table 3).

## 3 | RESULTS

### 3.1 | Selection of sources of evidence

In total, 193 studies reported in 242 articles were included in the review following removal of duplicate records, title and abstract, and

full-text screening (Figure 1). Reasons for exclusion at the full-text level are reported in Figure 1.

## 3.2 | Characteristics of sources of evidence

A summary of the characteristics of the interventions are described in Table 1. Majority of studies were conducted in the United States ($n = 112$). Most studies used an experimental study design ($n = 122$). Majority were conducted in the ECEC setting ($n = 99$) including preschools, nurseries, childcare, and family childcare homes. Nearly 53% of interventions ($n = 102$) addressed more than one socio-ecological level of the DONE framework, and of those, 70 studies reported at least one improved dietary outcome. There were 91 studies that targeted a single, and of those, 69 studies reported at least one improved dietary outcome. The most frequently addressed were individual ($n = 102$) and interpersonal ($n = 116$) level determinants. The duration of studies ranged from single-day interventions to four years, with the duration of most studies being less than 6 months ($n = 113$). Intensity of intervention varied greatly between studies where the frequency of sessions varied from daily to monthly and the length of sessions varied from brief ten-minute interventions to two hours. The sample size of studies ranged between 10 participants[105] to over 500,000 participants per repeated cross-sectional interval.[47]

## 3.3 | Results of individual sources of evidence

Child dietary intake outcomes are summarized by DONE framework categories in Tables 2 and 3.

## 3.4 | Synthesis of results

### 3.4.1 | Individual

*Biological*

There were 18 studies targeting biological determinants and all aimed to influence children's sensory perception and learned taste preferences (Table 2). Of these, 11 studies reported improvements in vegetable intake (Table 3). One study reported repeated exposure decreased vegetable consumption.[101] Of the 11 studies that reported improved outcomes, all interventions involved repeated taste exposure to vegetables offered at meal or snack times by parents in the home setting or ECEC staff in the ECEC setting.[73,84,134,146,165,166,176,177,193,195,226] The number of exposures ranged from daily to twice weekly. Additional strategies such as rewards, dips, encouraging conversations during mealtimes, parent modeling, and multi-sensory exposure may improve vegetable consumption.[84,134,146,176,226]

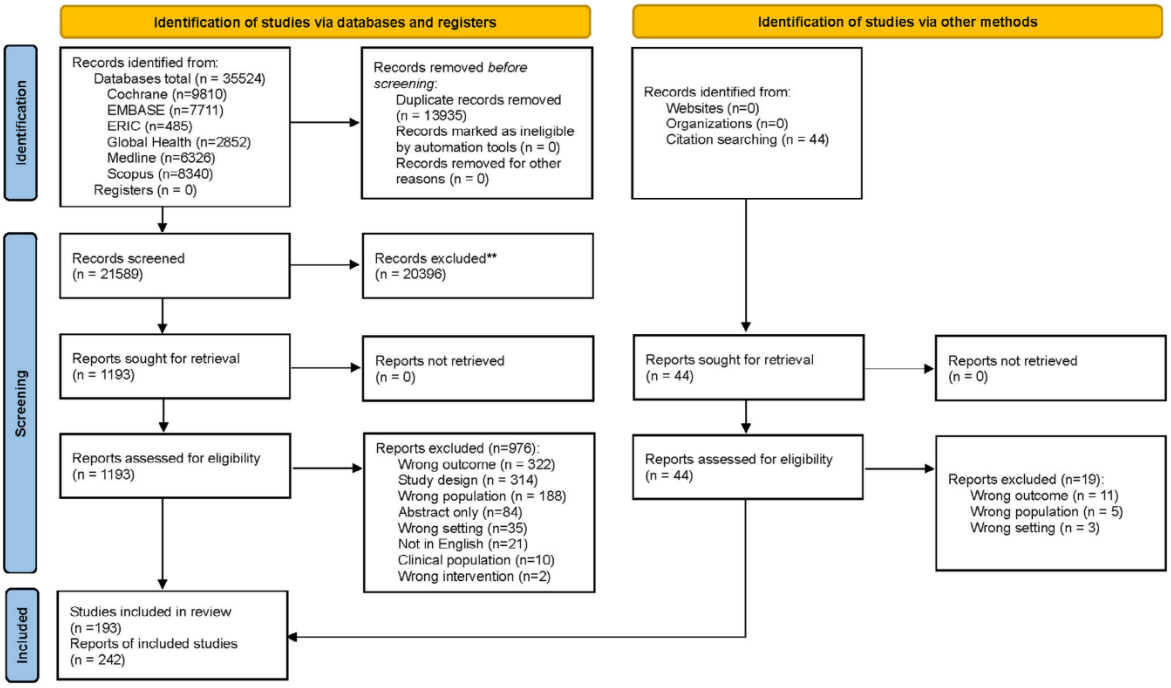


**FIGURE 1** Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) 2020 flow diagram for new systematic reviews which included searches of databases, registers, and other sources, as recommended by the PRISMA 2020 statement: an updated guideline for reporting systematic reviews.

**TABLE 1** Characteristics of included studies ($n = 193$).

| Study characteristics | Sub-category | Number of results (%) | References |
|---|---|---|---|
| Country | United States | 112 (58%) | 33–143 |
| | Australia | 18 (9%) | 144–161 |
| | United Kingdom | 18 (9%) | 162–179 |
| | Canada | 4 (2%) | 180–183 |
| | Chile | 4 (2%) | 184–187 |
| | Germany | 4 (2%) | 188–191 |
| | Netherlands | 4 (2%) | 192–195 |
| | Portugal | 4 (2%) | 196–199 |
| | Other European | 16 (8%) | 200–215 |
| | Other Asian | 5 (3%) | 216–220 |
| | Other | 4 (2%) | 221–224 |
| Study design | Experimental | 122 (63%) | 34–37,39,42,45,50,51,56–65,67–72,75,82,84–86,88,92,96–101,103,104,106,107,110,112,113,115,116,119–122,124,125,132,133,135–144,146,148,149,151–154,156–165,167–174,176,177,181–184,189,190,192,193,195,196,200–205,207,209–215,217,218,222,223,225 |
| | Quasi-experimental | 59 (31%) | 38,40,41,43,44,46,48,49,52–55,73,74,76–78,80,83,87,89,91,94,95,102,105,108,109,111,114,117,123,127–130,134,145,147,150,155,166,178,179,185,187,188,191,194,197–199,206,208,216,220,224,226 |
| | Analytical observational | 13 (7%) | 33,47,66,81,93,118,131,142,175,180,186,219,221 |
| Setting | Early childhood education and care | 99 (51%) | 33,34,38,41,44,46,50–53,56,57,59–61,63,64,70,71,73,74,81,83–87,94,96,97,99,101,103,104,106,107,109,112,113,122–125,127–129,132,134–137,139–143,145,151–153,157,159,160,162–164,167,171,172,176,180,181,183,184,187–193,195–198,201,205,206,209,212,213,215–217,219,220,222,224,226 |
| | Home | 44 (23%) | 35,36,42,45,47,54,55,66,67,69,72,79,80,82,88,89,93,100,102,111,115,118,120,130,131,133,138,146,148–150,154,156,161,165,166,169,173,174,177,182,200,203,210 |
| | Community | 21 (11%) | 37,40,43,49,68,76–78,95,98,105,114,117,144,147,175,214,218,221,223,227 |
| | Multiple settings | 20 (10%) | 62,65,75,90–92,110,116,119,121,168,170,185,186,194,199,204,207,208,211 |
| | Healthcare clinic | 7 (4%) | 39,48,108,158,178,179,202 |
| | Other | 2 (1%) | 58,155 |
| DONE Framework socioecological level[a] | Individual | 102 (53%) | 34,37,38,40,41,44,46,50,51,59–61,65,68–71,73,75,76,78,83,84,87,88,90–92,94–97,99–101,103,105,107,109,116,117,119,121,123–125,128,132–135,140–144,146,153,155,158,162–166,170–172,174,176,177,180,187,189–193,195,196,199,201,203–206,208,209,211–222,224,226 |
| | Interpersonal | 116 (60%) | 35–37,39,40,43–45,48,49,53,54,58–63,65,67–69,71,72,75–79,82,83,87,88,90–92,95–100,103,105,108–111,113,115–117,119–121,123,124,127,128,130,138,140,142,144,146–150,155,156,158,160,161,165–170,174,177–179,182,183,187–191,194,197,198,200–204,206–215,218–223,227 |
| | Environment | 73 (38%) | 33,36,42,45,47,51,52,54–57,62,64–67,74,75,80,81,85,86,89,90,93,96,97,102–104,106,107,112,114,116,118,122,124,127,129,131,133,136–139,142,145,147,151,152,154,157,159–161,164,168,173,180,181,184,186,188,191,194,201,203,207,211,213,215,221 |
| | Policy | 21 (11%) | 33,47,52,55,66,74,80,81,89,93,102,114,118,129,131,145,175,185,186,221,227 |
| Duration | 0 to <3 months | 89 (46%) | 34,36,38,39,41–44,58,65,69–72,75–79,82,84–87,91,95,99–101,103,104,106,111–113,117,124,125,130,132–137,139,141,143,144,146,149,152,153,155,156,158,161,163–167,169,171–174,176–179,183,190,192,193,196–198,205,206,208,209,216–218,220,223,224,226 |
| | 3 to <6 months | 24 (12%) | 46,51,54,59–61,68,73,90,96,115,128,140,145,154,168,170,175,187,195,211,213,221,222 |
| | 6 to < 12 months | 34 (18%) | 35,40,48,53,55–57,64,67,83,88,98,105,107,108,110,116,120–123,138,142,150,157,160,181,182,189,200,204,207,210,215 |
| | 12 to <24 months | 14 (7%) | 63,80,92,94,148,151,159,188,191,194,199,203,212,214 |
| | 24 to <36 months | 4 (2%) | 45,109,119,127 |
| | ≥ 36 months | 6 (3%) | 37,62,147,201,202,227 |
| | Other[b] | 22 (11%) | 33,47,49,50,52,66,74,81,89,93,97,102,114,118,129,131,162,180,184–186,219 |
| Sample size | <50 | 39 (20%) | 34,36,38,40,41,43,49,56,69,70,74,78,86,87,93,95,105,106,111–113,115,127,132,133,137,154,162,164,167,170,173,182,184,193,197,216,224,226 |

(Continues)

TABLE 1 (Continued)

| Study characteristics | Sub-category | Number of results (%) | References |
|---|---|---|---|
| | 50–150 | 49 (25%) | 39,50,54,55,58,68,72,77,79,84,85,88,90,91,96,98,101,102,104,108,110,114,117,119,120,135,136,139–141,144,148,149,151,157,163,166,169,174,176–178,183,198,199,208,209,212,223 |
| | 151–500 | 60 (31%) | 42,44,45,48,51,53,57,59,60,64,65,71,73,75,76,80,83,99,100,107,116,122,125,128–130,134,138,142,143,145,146,150,152,153,155,156,158,161,165,168,171,172,175,180,187–189,192,194–196,203–205,210,214,218,220,222 |
| | >500 | 45 (23%) | 33,35,37,46,47,52,61–63,66,67,81,82,89,92,94,97,103,109,118,121,123,124,131,147,159,160,179,181,185,186,190,191,200–202,206,207,211,213,215,217,219,221,227 |

[a]Studies may address more than one SEM level.
[b]Other includes studies that did not report duration or examined policy implementation.

*Demographic*

No studies addressed demographic determinants (Table 2).

*Psychological*

A total of 87 studies addressed psychological determinants and of these, 60 studies reported improvements in one or more measures of dietary intake with the intervention (Table 2). Most studies ($n = 76$) addressed children's food knowledge, skills, and abilities through group nutrition education sessions, and of those, a majority of interventions reported improvements in vegetable and combined fruit and vegetable intake and a decrease in consumption of energy-dense nutrient-poor foods (Table 3). Other dietary intake measures reported included energy intake and fat intake. The three studies that reported intervention effects on energy showed decreased energy intake.[37,187,222] Two studies reported decreased total fat intake[187] and saturated fat intake.[59] Most interventions addressing children's food beliefs, such as involving children in gardening and food preparation activities, showed improved fruit and vegetable intake, and reduced intake of energy-dense nutrient-poor foods and SSBs (Table 3). Nine of 11 interventions addressing children's eating regulation resulted in improvements in all outcomes, with most reporting improvements in vegetable intake and combined fruit and vegetable intake and decreased energy-dense nutrient-poor food intake (Table 3). Eating regulation interventions included mindful eating activities, offering a variety of vegetables, and portion-size plates. Positive outcomes were reported for ECEC-based interventions that incorporated nutrition education lessons delivered by ECEC staff into the curriculum.[46,51,59,65,73,83,90,92,97,103,116,123,125,128,135,153,180,187,192,204–206,209,211,216,217,219,222] In addition to nutrition education, some interventions included an interactive component such as food preparation, cooking, and gardening activities.[40,51,65,73,76,78,92,95,100,105,116,117,123,124,189,206,209,214,220,221,224]

Other strategies used to support and reinforce children's food knowledge, beliefs, and habits included the use of storybooks and/or puppets[69,76,99,103,123,128,135,158,171,192,224] and rewards such as stickers or praise.[84,99,103,133,166,174,224] Many studies also included a parent component in the intervention, however involvement ranged from newsletters and information to targeted family-based workshops.[37,40,59,65,68,69,73,76,78,83,90,92,95,103,105,116,117,123,124,128,144,158,187,189,203,204,209,218,220,222] Eight studies also included environment and policy changes to support children's eating behaviors.[65,97,116,124,180,203,211,221]

*Situational*

There were 23 studies that included strategies to address related health behaviors including physical activity and screen time (Table 2). Of those, 17 studies showed improvement in one or more measures of dietary intake (Table 2). Most interventions decreased consumption of energy-dense nutrient-poor foods (Table 3). Other dietary intake measures reported included energy intake and fat intake. Two studies reported on energy intake and both decreased energy intake.[37,222] Three studies reported total fat intake but found no significant changes. Two studies reported saturated fat intake, and one study found intervention reduced intake.[59] Of the 17 studies reporting improved dietary intake outcomes, most were family-based, multicomponent interventions that involved both healthy eating and physical activity and conducted in the community setting.[37,40,68,78,95,117,144,147,158,214,228] Other interventions involved incorporating both healthy eating and physical activity components in a classroom-based program delivered by ECEC staff.[59,92,124,128,211,222]

### 3.4.2 | Interpersonal

*Social*

A total of 117 studies addressed determinants related to social factors. Of these, 81 studies reported improvements in one or more dietary intake outcomes (Table 2). There were 13 studies targeting family food culture such as cooking and growing, with most interventions reported improvements in children's vegetable intake (Table 3). Most studies addressing social influence such as peer modeling, reported improved fruit and vegetable intake, and reduced intake of energy-dense nutrient-poor foods (Table 3). Interventions incorporating components of social or group support for families demonstrated increased vegetable intake and reduced consumption of energy-dense nutrient-poor foods and SSBs in most studies (Table 3). Parental

**TABLE 2** Summary of nutrition interventions studies targeting children aged 2–5 years and reported dietary intake outcomes mapped to the determinant of nutrition and eating framework stem categories.

| | | Biological | Demographic | Psychological | Situational | Social | Cultural | Product | Micro | Meso/macro | Industry | Government |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All outcomes [a] | *n* total [b] | 18 | 0 | 87 | 23 | 117 | 4 | 9 | 37 | 32 | 1 | 20 |
| | Improved (%) [c] | 67% | 0% | 69% | 74% | 69% | 50% | 100% | 68% | 66% | 100% | 85% |
| Diet quality | *n* total | 0 | 0 | 9 | 5 | 13 | 0 | 0 | 5 | 7 | 0 | 5 |
| | Improved (%) | 0% | 0% | 33% | 40% | 38% | 0% | 0% | 60% | 57% | 0% | 60% |
| Fruit | *n* total | 0 | 0 | 33 | 11 | 47 | 0 | 1 | 16 | 22 | 0 | 11 |
| | Improved (%) | 0% | 0% | 39% | 18% | 23% | 0% | 0% | 44% | 27% | 0% | 36% |
| Vegetables | *n* total | 18 | 0 | 53 | 12 | 60 | 0 | 3 | 21 | 24 | 0 | 11 |
| | Improved (%) | 61% | 0% | 55% | 42% | 45% | 0% | 100% | 48% | 38% | 0% | 18% |
| Combined FV | *n* total | 0 | 0 | 17 | 2 | 29 | 3 | 0 | 11 | 8 | 0 | 4 |
| | Improved (%) | 0% | 0% | 47% | 50% | 34% | 33% | 0% | 36% | 50% | 0% | 25% |
| EDNP | *n* total | 0 | 0 | 26 | 7 | 40 | 1 | 0 | 8 | 16 | 0 | 7 |
| | Improved (%) | 0% | 0% | 58% | 86% | 55% | 0% | 0% | 13% | 50% | 0% | 57% |
| SSB | *n* total | 0 | 0 | 27 | 9 | 48 | 2 | 0 | 11 | 6 | 1 | 4 |
| | Improved (%) | 0% | 0% | 30% | 33% | 33% | 50% | 0% | 18% | 33% | 0% | 25% |

Abbreviations: FV, fruit and vegetables; EDNP, energy-dense nutrient-poor; SSB, sugar-sweetened beverages.

[a]All outcomes include other reported outcomes such as energy intake not categorized in the table. Diet quality, fruit, vegetables, combined FV, EDNP, and SSB outcomes reported as outlined by COS-EPOCH.[28]

[b]*n* total indicates the number of studies mapped to the Determinants of Nutrition and Eating Framework stem categories.

[c]Improved outcome (%) heat map describes the percentage of studies with at least one improved outcome measure. Gray cells indicate no studies that addressed that determinant category and outcome. Red cells indicate 0–20% studies reporting improved outcomes, orange indicates 21–40% studies reporting improved outcomes, yellow indicates 41–60% studies reporting improved outcomes, light green indicates 61–80% studies reporting improved outcomes, and dark green indicates 81–100% studies reporting improved outcomes.

**TABLE 3** Summary of nutrition interventions studies targeting children aged 2–5 years and reported dietary intake outcomes mapped to the determinants of nutrition and eating framework leaf categories.

| | All outcomes[a] | | Diet quality | | Fruit | | Vegetables | | Combined FV | | EDNP | | SSB | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leaf category | *n* total[b] | *n* (%) improved[c] | *n* total | *n* (%) improved | *n* total | *n* (%) improved | *n* total | *n* (%) improved | *n* total | *n* (%) improved | *n* total | *n* (%) improved | *n* total | *n* (%) improved |
| **Individual** | | | | | | | | | | | | | | |
| **Biological** | | | | | | | | | | | | | | |
| Sensory Perception | 18 | 11 (61%) | 0 | 0 (0%) | 0 | 0 (0%) | 18 | 11 (61%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) |
| **Psychological** | | | | | | | | | | | | | | |
| Mood And Emotions | 1 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 1 | 0 (0%) | 1 | 0 (0%) | 0 | 0 (0%) |
| Food Knowledge, Skills, and Abilities | 76 | 50 (66%) | 2 | 0 (0%) | 20 | 10 (50%) | 32 | 24 (75%) | 10 | 7 (70%) | 17 | 14 (82%) | 17 | 8 (47%) |
| Food Habits | 3 | 3 (100%) | 0 | 0 (0%) | 0 | 0 (0%) | 3 | 3 (100%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) |
| Food Beliefs | 36 | 27 (75%) | 3 | 1 (33%) | 12 | 7 (58%) | 20 | 15 (75%) | 6 | 3 (50%) | 7 | 4 (57%) | 4 | 4 (100%) |
| Eating Regulation | 11 | 9 (82%) | 1 | 0 (0%) | 3 | 1 (33%) | 7 | 4 (57%) | 3 | 2 (67%) | 2 | 2 (100%) | 1 | 0 (0%) |
| Weight Control Cognitions and Behaviors | 1 | 0 (0%) | 0 | 0 (0%) | 1 | 0 (0%) | 1 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) |
| **Situational** | | | | | | | | | | | | | | |
| Related health Behaviors | 23 | 17 (74%) | 5 | 2 (40%) | 12 | 3 (25%) | 13 | 6 (46%) | 2 | 1 (50%) | 7 | 6 (86%) | 10 | 4 (40%) |
| **Interpersonal** | | | | | | | | | | | | | | |
| **Social** | | | | | | | | | | | | | | |
| Family Structure | 2 | 1 (50%) | 0 | 0 (0%) | 2 | 1 (50%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 1 | 1 (100%) |
| Family Food Culture | 13 | 10 (77%) | 3 | 1 (33%) | 5 | 2 (40%) | 7 | 4 (57%) | 3 | 1 (33%) | 2 | 0 (0%) | 8 | 2 (25%) |
| Social Influence | 9 | 6 (67%) | 0 | 0 (0%) | 6 | 4 (67%) | 8 | 5 (63%) | 1 | 1 (100%) | 3 | 2 (67%) | 4 | 0 (0%) |
| Social Support | 14 | 12 (86%) | 1 | 0 (0%) | 6 | 1 (17%) | 9 | 5 (56%) | 3 | 1 (33%) | 3 | 3 (100%) | 8 | 6 (75%) |
| Parental Resources and Risk Factors | 97 | 65 (67%) | 11 | 4 (36%) | 38 | 9 (24%) | 46 | 18 (39%) | 28 | 10 (36%) | 34 | 19 (56%) | 41 | 14 (34%) |
| Parental Attitudes and Beliefs | 25 | 16 (64%) | 3 | 2 (67%) | 6 | 1 (17%) | 8 | 2 (25%) | 7 | 2 (29%) | 7 | 4 (57%) | 15 | 5 (33%) |
| Parental Behaviors | 24 | 14 (58%) | 3 | 0 (0%) | 9 | 3 (33%) | 10 | 5 (50%) | 7 | 2 (29%) | 7 | 3 (43%) | 14 | 5 (36%) |
| Parental Feeding Styles | 25 | 19 (76%) | 4 | 3 (75%) | 8 | 2 (25%) | 12 | 5 (42%) | 7 | 5 (71%) | 8 | 5 (63%) | 5 | 0 (0%) |
| **Cultural** | | | | | | | | | | | | | | |
| Cultural Cognitions | 4 | 2 (50%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 3 | 1 (33%) | 1 | 0 (0%) | 2 | 1 (50%) |
| **Environment** | | | | | | | | | | | | | | |
| **Product** | | | | | | | | | | | | | | |
| Intrinsic Product Attributes | 8 | 8 (100%) | 0 | 0 (0%) | 1 | 0 (0%) | 3 | 3 (100%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) |
| **Micro** | | | | | | | | | | | | | | |
| Portion Size | 7 | 7 (100%) | 0 | 0 (0%) | 4 | 3 (75%) | 6 | 5 (83%) | 1 | 1 (100%) | 0 | 0 (0%) | 0 | 0 (0%) |
| | 20 | 12 (60%) | 4 | 3 (75%) | 8 | 3 (38%) | 10 | 3 (30%) | 0 | 0 (0%) | 4 | 1 (25%) | 7 | 1 (14%) |

**TABLE 3** (Continued)

| Leaf category | All outcomes[a] | | Diet quality | | Fruit | | Vegetables | | Combined FV | | EDNP | | SSB | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *n* total[b] | *n* (%) improved[c] | *n* total | *n* (%) improved | *n* total | *n* (%) improved | *n* total | *n* (%) improved | *n* total | *n* (%) improved | *n* total | *n* (%) improved | *n* total | *n* (%) improved |
| Home Food Availability and Accessibility | | | | | | | | | | | | | | |
| Eating Environment | 10 | 7 (70%) | 2 | 1 (50%) | 3 | 1 (33%) | 4 | 2 (50%) | 4 | 1 (25%) | 3 | 0 (0%) | 5 | 1 (20%) |
| **Meso/Macro** | | | | | | | | | | | | | | |
| Environment Food Availability and Accessibility | 32 | 23 (64%) | 7 | 4 (57%) | 22 | 6 (27%) | 24 | 9 (38%) | 8 | 4 (50%) | 21 | 9 (43%) | 6 | 3 (50%) |
| Societal Initiatives | 1 | 1 (100%) | 0 | 0 (0%) | 1 | 0 (0%) | 1 | 1 (100%) | 0 | 0 (0%) | 1 | 1 (100%) | 1 | 1 (100%) |
| **Policy** | | | | | | | | | | | | | | |
| **Industry** | | | | | | | | | | | | | | |
| Industry Influence | 1 | 1 (100%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 0 | 0 (0%) | 1 | 0 (0%) |
| **Government** | | | | | | | | | | | | | | |
| Government Regulations | 17 | 14 (82%) | 5 | 3 (60%) | 10 | 4 (40%) | 10 | 3 (30%) | 3 | 1 (33%) | 10 | 3 (30%) | 3 | 0 (0%) |
| Campaigns | 3 | 3 (100%) | 0 | 0 (0%) | 1 | 1 (100%) | 1 | 0 (0%) | 1 | 0 (0%) | 2 | 2 (100%) | 1 | 1 (100%) |

Abbreviations: FV, fruit and vegetables; EDNP, energy-dense nutrient-poor; SSB, sugar-sweetened beverages.

[a]All outcomes includes other reported outcomes such as energy intake not categorized in the table. Diet quality, fruit, vegetables, combined FV, EDNP, and SSB outcomes reported as outlined by COS-EPOCH.[28]

[b]Total (*n*) indicates the number of studies mapped to the Determinants of Nutrition and Eating Framework leaf categories.

[c]Improved *n* (%) indicates the number and percentages of studies that reported improvements in dietary outcomes.

resources and risk factors, which focuses on parent nutrition knowledge, was the most frequently addressed determinants ($n = 97$). Of these studies, most interventions reported reduced energy-dense nutrient-poor food intake but no significant differences for diet quality, fruit, vegetable, and SSB consumption were found (Table 3). Most studies addressing parental attitudes and beliefs reported improvements in children's diet quality and decreased consumption of energy-dense nutrient-poor foods (Table 3). Of the studies that addressed parental behaviors, most reported non-significant outcomes on children's dietary intake (Table 3). Most studies addressing parental feeding styles reported improvements in diet quality, combined fruit and vegetable intake, and reduced energy-dense nutrient-poor food intake (Table 3). Of the 80 studies resulting in improved dietary outcomes, majority of interventions were conducted in the home setting, via home visits, telephone, or online[35,36,54,62,69,72,79,82,100,111,120,146,148–150,161,165,166,169,174,177,182,200,203,210] or in the ECEC setting with a parent component.[53,59,63,65,83,90,92,94,97,99,103,113,116,123,124,128,160,167,187,189,194,197,198,204,206,208,209,211,219,220,222] Most studies were multicomponent and used a range of behavior change techniques including group educational workshops or sessions for parents to provide information and build skills.[35,37,39,40,53,58,62,65,68,76–78,90,92,95,97,98,105,116,117,128,144,158,160,178,179,187,189,194,197,198,202,203,206,214,218] Other intervention strategies included individual counseling using motivational interviewing, home visits and feedback reports from health professionals to assist with goal setting, self-monitoring, and habit formation.[48,53,54,62,65,68,72,98,100,108,120,149,150,161,169,182,198,202,204,214] Interventions also included home based tasks or activities, take home written materials, and text message prompts and reminders to cue parental behaviors.[36,37,53,54,59,63,65,69,83,90,92,98,99,103,111,117,120,123,124,128,144,147,160,161,177,197,198,204,208,209,211,218,220,222,227] Some studies created opportunities for parents and children to receive social support peers and other families, through online discussion boards.[79,82,149,203] Digital tools including apps, websites, and Facebook were used to deliver nutrition education and support behavior change.

*Cultural*

There were four studies that addressed families' cultural values, beliefs, and perceptions about weight. Two of these studies reported improvement in one or more dietary intake outcomes (Table 2). Of the two studies that improved outcome measures, both were multi-level, multi-component studies.[40,128] One study, a culturally appropriate center-based program delivered by trained teachers, reported improvements in combined fruit and vegetable consumption.[128] One study was a community-based program delivered by trained bilingual community members and reported improvements in SSB, water, and milk intake.[40]

### 3.4.3 | Environment

*Product*

All studies addressing product attributes showed improvements in at least one outcome measure of children's dietary intake (Table 2). There were eight studies that addressed intrinsic product attributes such as adjusting the nutritional composition of foods offered (Table 3). One study addressed extrinsic product attributes through policy to change food labeling. Strategies to replace or substitute meals and snacks with vegetables improved dietary intake.[85,112,173] Seven studies examined substituting high energy density with low energy density foods or beverages such as soy-enhanced lunches and reduced-fat milk. Of these, four studies reported decreased energy intake.[85,86,112,137] One study reported increased energy intake which was higher than recommendations.[56] One study found that replacing meals with slowly digested carbohydrates lowered energy intake.[184] Policy changes to the front-of-package labeling of energy-dense nutrient-poor foods was associated with increased non-nutritive sweetener intake in one study.[186] No studies addressing product attributes reported on diet quality, energy-dense nutrient-poor food intake, or SSB intake. Across the studies that reported one or more improved outcome measures, the majority of interventions were single-level addressing product attributes in the ECEC food environment.[56,85,86,112,137,184]

*Micro*

A total of 37 studies addressed determinants in the micro food environment including portion size, availability and accessibility of healthy foods, and providing a supportive eating environment at home. Of these, 25 studies reported improvement in at least one outcome measure of children's dietary intake (Table 2). Of the studies that addressed portion size by adjusting the amount of food served to children at meal or snack times, most interventions improved fruit and vegetable intake (Table 3). Three of four studies showed that interventions addressing home food availability and accessibility, such as the provision of food packages, improved diet quality (Table 3). Studies addressing the home eating environment, such as changing mealtime structures and creating positive meal environments, reported improvements in diet quality and vegetable intake, however, this was inconsistent. Of the 25 studies with one or more improved outcomes, the majority were multi-level interventions.[36,54,55,62,65,66,80,90,93,102,118,131,133,161,164,203,211] Key strategies of successful interventions included increasing the portion size of fruit and vegetables at meals and snacks,[104,106,136,137,139,164,173] and teacher delivered program with home and classroom environment component.[65,90,211] Change in policy at the federal level to provide food subsidies for healthy foods was associated with improved dietary outcomes.[55,66,80,93,102,118,131]

*Meso/macro*

There were 32 studies that addressed the meso/macro environment, and of these, 21 studies reported significant improvements in at least one measure of children's dietary intake (Table 2). Studies focusing on the meso/macro environment predominantly targeted food availability and accessibility in ECECs. Four of seven studies reported improvements in children's diet quality (Table 3). Interventions that reported improved outcomes used strategies to target the food environment in ECEC settings such as the implementation of staff

training,[97,103,145,147,157,180,194] health professional feedback and support to revision and implementation of menus and nutrition policy,[64,97,116,122,124,145,147,157,159,180] and provision of healthy snacks and water stations.[103,160,211]

### 3.4.4 | Policy

*Industry*

One study addressed industry influence (Table 2). The intervention provided a template of activities such as lobbying and advocacy for SSB taxation to be implemented by local project teams.[221] The intervention was associated with increased water intake but no changes in SSB were found (Table 3).

*Government*

Seventeen of 20 studies that included components involving government-level regulations or campaigns to promote healthy eating reported improvement in at least one measure of dietary intake with the intervention (Table 2). Most government-level interventions reported improvement in diet quality (Table 3). Most government campaigns showed improvement in fruit intake and reduced consumption of energy-dense nutrient-poor foods (Table 3). Of the 17 studies with one or more improved outcomes, most interventions were implemented as a long-term policy change. Implementation of healthy food subsidies for low-income families as part of the Special Supplemental Nutrition program for Women, Infants, and Children (WIC) in the United States was associated with improved dietary intake.[55,66,80,93,102,118,131] Healthy food subsidies were also used in the ECEC setting in the United States in conjunction with meal pattern requirements and found improved dietary intake.[33,52,74,81] Other successful strategies implemented in the ECEC setting included a state-wide change in dietary guidelines and a program to implement staff training and menu and policy feedback.[129,145] Two studies conducted in Chile found that mandated front of package warning labels, restricting marketing directed at children and banning sale or promotion of energy dense nutrient poor foods in schools and nurseries improved dietary intake.[185,186] However, energy dense nutrient poor food consumption changes were not mediated by changes in advertising exposure which may suggest other aspects of the policy driving changes.[185] The policy changes were associated with non-nutritive sweetener intake in children.[186] One study reported a social marketing intervention was associated with improved snacking habits.[175]

## 4 | DISCUSSION

### 4.1 | Summary of evidence

This scoping review consolidates the evidence from studies addressing dietary intake in preschool children published in the last 24 years to provide an in-depth overview of interventions in the context of the food system. We identified 193 primary studies, mapped the evidence to the DONE framework, and quantified the number of studies associated with reporting improved outcomes for each determinant. Of the included studies, most interventions addressed social determinants, such as parental nutrition knowledge, skills, habits, and feeding styles, and children's nutrition knowledge and skills at the individual level. These interventions may support improvements in dietary intake in individual children, however, we found gaps in the evidence for other parts of the system which, if considered, may result in more widespread and equitable changes in young children's dietary patterns.

At the individual level, most interventions targeted psychological determinants which included strategies to improve children's nutrition knowledge and skills. Most studies showed targeting children's knowledge using strategies such as nutrition education positively influenced fruit and vegetable intake. However, a systematic review of interventions for increasing fruit and vegetable consumption found that the evidence supporting nutrition education interventions is of low quality and only showed small improvements.[229] We found that interventions that addressed other health behaviors such as physical activity and screen time resulted in improved dietary intake, particularly for energy-dense nutrient-poor foods. This is not surprising as higher screen time is associated with increased energy-dense nutrient-poor food intake.[230] Additionally, multi-component interventions that target multiple obesogenic behaviors result in better dietary outcomes.[231]

Parental nutrition knowledge, skills, and abilities were the most targeted determinant, however, the evidence for improving children's diets was mixed which is consistent with the findings of previous systematic reviews. Hodder et al found overall no effect of parent nutrition education interventions on child fruit and vegetable intake.[229] However, another review reported that childcare-based interventions with parental involvement showed promising effects on nutritional-related behavior with interventions that actively involved parents increasing the success of behavior change in children.[232] There was also little evidence available for addressing cultural beliefs and behaviors. This suggests that further research is needed to determine the most effective approaches for addressing parent-related determinants and how to best tailor interventions for culturally and linguistically diverse populations. Combining interventions to also target other psychosocial and parenting variables may improve the success of interventions such as parenting and feeding styles,[233] parental behaviors and modeling,[16] and social influence from siblings[234] and peers even at this young age.[235] A systematic review is recommended to identify the most effective strategies to improve the success of parent interventions to improve child dietary intake.

Within children's food environments, home food availability and accessibility have been identified as a critical but understudied determinant.[22] Findings from this scoping review suggest that there were some positive effects, predominantly from studies focusing on healthy food subsidy programs in low-income families or increasing portion size to increase fruit and vegetable intake. However, there remains an opportunity to identify effective strategies for decreasing intakes of energy-dense nutrient-poor foods and SSB in the home setting. In a systematic review, Johnson et al found limited evidence to support

the association between availability in the home and reduced intake of studies on child intake of energy-dense nutrient-poor food and beverages.[236]

The results appear promising for interventions addressing product attributes. Particularly, there is evidence to support the substitution of meals and snacks served to children with fruit and vegetables to improve consumption and lower energy intake in the home and ECEC settings. However, energy intake outcomes should be interpreted with caution due to misreporting which may result from subjective parent-reported dietary assessment methods.[237] Given the success, effectiveness of scaling up these interventions is recommended particularly in the ECEC setting, where menu policy guidelines can reach many children.

Nutrition interventions in the ECEC setting are well described, however, we found that the evidence for improving children's dietary outcomes was mixed. Similarly, a Cochrane review found that interventions in the ECEC setting may improve fruit and vegetable consumption but had little to no effect on energy-dense nutrient-poor food and SSB, however, the certainty of these findings was limited due to the quality of the evidence.[19] Despite most of the included studies being conducted in the ECEC setting, there was a lack of policy or sustainability components to embed interventions in the setting. To improve the effectiveness of interventions in the ECEC setting, sustainability needs to be included in the design and adoption phase, and wider policy-level action to ensure consistent implementation across the ECEC system and further implementation support is recommended.[238,239]

The results appear promising for government policy and regulations on children's overall diet quality and energy-dense nutrient-poor food consumption, but the evidence was limited for fruit and vegetable intake. The majority of studies examined the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), and Child and Adult Care Food Programs (CACFP) conducted in the United States which provides healthy food subsidies for low-income households in the home and ECEC setting respectively. Similar to the findings from this scoping review, systematic reviews of the evidence for WIC and CACFP programs indicate that while healthy food subsidies improve purchasing, availability, and accessibility of fruits and vegetables, there is inconsistent evidence that this leads to improved dietary intake in children.[240,241] The federal nutrition assistance programs have great potential to reach and support children, however, it has been suggested that further consideration of the broader context of food insecurity, fragmented childcare system in the United States, and adequacy of implementation structure for these programs is needed ensure effective implementation at the population level.[242] Leveraging both child nutrition and social protection policy interventions such as the implementation of healthy food programs in childcare in conjunction with subsidies to make childcare more affordable is needed to address the underlying determinants of household food insecurity experienced by low-income families.[243] This review found limited studies outside of the United States designed specifically for children from low socioeconomic status communities that leverage both nutrition and social protection policies, suggesting a need for more interventions that target predisposing factors to health and nutrition inequities.

Exposure to food marketing has been shown to have a negative impact on pre-school children's food intake, food choice, and food preferences.[244,245] Currently, many countries have adopted industry self-regulation, however mandatory policy approaches to restrict food marketing are more likely to reduce exposure.[246] Despite endorsement for stronger legislative action from government to protect children from harmful food marketing,[247] implementation across high-income countries is poor. This scoping review found that the only evidence specifically targeting and recognizing the needs of children comes from Chile, as part of a broader evaluation of policies and actions being implemented in Latin America.[248] Chile's Food labelling and Advertising Law provides an example of the need for policy coherence and how a comprehensive package of policy options is needed to address multiple determinants and support effective implementation. The initial results are promising and provide evidence of scalability and may act as a "tipping point" for other countries to justify implementation of food marketing policy and legislation around nutrition labeling.[249]

The current review examines the evidence for positive dietary change in preschool-aged children against the DONE framework to discover which determinants are understudied and where further evidence is needed. For clarity, the results are presented according to distinct framework categories. However, most studies were complex interventions, targeting multiple determinants across different levels. Potential interactions were not fully captured in this scoping review as most included studies did not report synergistic effects. The evidence suggests that whole-of-system interventions addressing multiple determinants are needed to improve children's diets.[250] Recommendations for interventions should take a systems approach to target multiple levels and interactions between determinants.[251] Furthermore, most included studies reported fruit and vegetable outcomes. Additional high-quality studies to measure the effect on consumption of energy-dense and nutrient-poor foods and overall diet quality are recommended to provide a better picture of the effectiveness of early childhood nutrition interventions.

## 4.2 | Limitations

As this was a scoping review, we did not perform a quality assessment and as such included studies may be subject to various biases and the quality of evidence may vary. However, as the purpose of the review was to map the evidence and not to estimate intervention effect size, a scoping review was used which allowed for the inclusion of these studies to provide a complete and comprehensive overview.[252] Subsequent systematic reviews and meta-analysis with risk of bias and sub-group analysis assessments can be undertaken as recommended based on the results of this scoping review to determine effectiveness of interventions targeting specific determinants.

Given the large body of literature on early childhood nutrition, it is important to consolidate and map the evidence to identify gaps and

provide guidance for further research. A significant strength of this scoping review is the level of detail included by using the DONE framework to systematically map early childhood nutrition interventions. We were able to map the evidence to the framework of 411 determinants and then categorize these into leaf and stem-categories to synthesize and provide an overview of the evidence. Gaps in the evidence-base and areas where more primary studies are warranted to enable systematic reviews and causality to be determined were identified. The framework provides a novel and systematic way to categorize a broad range of determinants relevant to children, however, iterative updates are needed to accurately reflect current determinants and their interactions as they change, and new priorities arise.

## 5 | CONCLUSION

This review provides a systematic map of early childhood nutrition interventions. Interventions targeting children's individual psychological and biological determinants are well studied and can be effective at improving children's dietary intake. Social determinants, particularly parental nutrition knowledge, skills, attitudes, and beliefs were commonly addressed, however, there is limited evidence that targeting this leads to improved dietary outcomes in children. There is evidence to suggest interventions addressing environment and policy-level determinants may improve the success of interventions. While most studies were conducted in ECEC settings, there was a lack of policy to support cohesive implementation and sustainment of interventions. Manipulating the nutritional composition of meals and snacks provided to children at home and in the ECEC setting is a promising but under-explored gap that should be leveraged. Interventions addressing policy-level determinants including healthy food subsidy programs and food marketing and labeling laws are recommended as implementation is currently limited to the Unites States and Chile.

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### CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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**Appendix 3.3** Publication resulting from Chapter Four

*(Appears on next page)*

nutrients

MDPI

Article

# Contextual Influences on the Success of Healthy Eating Policies and Practices in Australian Early Childhood Education Centres: A Qualitative Study with Directors

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## Abstract

Background/Objectives: Early childhood education and care is an ideal setting to promote healthy eating behaviours in young children. However, successful implementation and sustainment of healthy eating policies and practices remains a key challenge in the Australian early childhood education and care (ECEC) context. This study aimed to understand the contextual factors influencing early childhood education directors' decisions to implement healthy eating policies and practices. Methods: Twelve directors from centre-based long day care centres in New South Wales, Australia, participated in semi-structured interviews. Interview data were analysed using reflexive thematic analysis and the Consolidated Framework of Implementation Research. Results: Directors ($n = 12$) described alignment with centre values and goals, compatibility with work infrastructure, local champions to lead implementation, and external partnerships with government support services as key facilitators. Directors identified a need for further support to address factors within the broader ECEC sector. Directors described a lack of external partnerships with the community, competing demands for available resources, unrealistic expectations from guidelines and parents, and inconsistent practices across settings as factors inhibiting implementation success. Conclusions: Implementation and sustainment of healthy eating policies and practices can be improved by strengthening parent and community partnerships, investment in the workforce, and a coordinated approach to the provision of support.

**Keywords:** childcare; contextual factors; diet; health promotion; implementation; policy; preschool

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## 1. Introduction

Early childhood is characterised by rapid physical, social, emotional, and cognitive growth and is a critical period for ensuring children reach their developmental potential [1]. Optimal diet and nutrition in early childhood is fundamental for prevention of nutrient

deficiencies [2], as well as motor and cognitive development [3] for ensuring school readiness [4]. The benefits of early exposure to good nutrition also extends beyond childhood and is associated with healthier diet quality [5] and reduced risk of cardiometabolic disease later in life [6].

Early childhood education and care (ECEC) centres have been identified as ideal settings for early childhood interventions to promote intake of healthy foods [7]. The ECEC setting provides a critical opportunity to reach large numbers of children and foster healthy eating behaviours. In Australia, almost 60% of children aged five years or under attended a centre-based day care and spent, on average, 27 h per week in care [8]. Children consume up to two-thirds of their recommended daily intake while in care, which can be influenced by many factors, including types and portion sizes of food served, meal service type, and feeding practices in the ECEC setting [9].

Recognising the important role that ECEC services plays in shaping healthy eating habits, most high-income countries have developed national or jurisdictional regulations and guidelines for the childcare sector, that recommend implementation of a number of healthy eating best practices [10]. Such practices include providing meals aligned with national dietary guidelines, offering nutrition education for children, establishing written nutrition policies, promoting supportive feeding practices, and creating healthy mealtime environments. However, the implementation of best practice standards that are consistent with such guidelines remains poor. For example, an assessment of ECECs in the United States found that centre-based services, on average, implemented only 7 out of 15 recommended nutrition practices [11]. In Australia, it has been reported that only 18% of centre-based services had all educators trained in nutrition [12]. Implementation factors remain a key challenge when facing sustained implementation of healthy eating policies and practices in the setting [13]. Adoption, implementation, and sustained delivery of nutrition interventions in the ECEC setting is complex, influenced by multiple factors and stakeholders [14]. It is thus important to understand how context, which describes the circumstances and factors surrounding implementation, can influence the desired outcomes [15,16]. Addressing contextual barriers and facilitators surrounding implementation can support the successful translation of research into sustained practice [17]. However, early childhood nutrition intervention studies rarely consider the broader environmental and policy context [18].

*Intervention and Policy Context in Australia*

In Australia, the ECEC sector is regulated through the National Quality Framework, which assesses centres against seven quality standards areas [19]. The standards related to nutrition state that "Healthy eating [. . .] are promoted and appropriate for each child" [19]. However, food provision guidelines, implementation support, and funding mechanisms to support centres to operationalise standards related to nutrition vary across states and territories [20]. Within the state of New South Wales (NSW), the Caring for Children framework was developed to provide practical guidelines on food, nutrition, and learning experiences [21]. Additionally, a statewide government-funded early childhood initiative, *Munch & Move*, has been implemented by Local Health District services to support the implementation of healthy eating and physical activity within ECEC centres [22]. Currently, only three out of eight states and territories in Australia have access to funded statewide nutrition programs.

Adequate implementation of recommended evidence-based healthy eating practices across Australia remains low, particularly for implementation of written nutrition policy, encouraging children to consume age-appropriate beverages, providing healthy eating education to children and families, and providing training and support to educators [23]. In

the state of Victoria, a study found that, while government support services improved implementation of menu planning guidelines and menu quality, this did not always translate into menu compliance [24]. There remains an opportunity to better understand the factors influencing implementation of healthy eating policies and practices in the Australian ECEC setting to maximise potential benefits for young children.

In ECEC centres, directors play an important role in educational programming and organisational management, including managing staff, overseeing budget, and ensuring compliance with regulations [25]. To improve implementation of healthy eating in the ECEC setting, policies and practices need to reflect the challenges centre directors face in their roles and the context within which they are situated [26]. Qualitative research methods can generate meaningful data and provide an in-depth understanding of individuals' unique experiences and context [27]. The aim of the results is not to generalise for broader populations but to provide rich descriptions to determine transferability of results in other contexts [28]. In this focal study of ECEC centres located in NSW, this offers useful insights to address the specific challenges faced in this context and inform implementation in other contexts.

Qualitative studies investigating the challenges in meeting dietary guidelines and achieving healthy food environments have previously been explored in the states of Queensland and Victoria; however, the existing studies focus on organisational factors within the ECEC setting context [24,29]. There remains a research gap in understanding the broader environmental and policy context and how these factors interact with the inner setting to provide understanding of a system for developing effective policy-level action. Specifically, this has not been explored in NSW, where 845,000 children attend centre-based care [19]. The aim of this study was to understand the experiences of directors regarding how contextual factors influence their decisions to implement healthy eating policies and practices in centre-based ECEC settings in NSW, Australia.

## 2. Materials and Methods

This study follows the Standards for Reporting Qualitative Research (SRQR) reporting guideline [30]. This study was approved by the Sydney Local Health District Human Research Ethics Committee (Project Number X23-0379).

### 2.1. Study Design

This study used an interpretivist approach adopting a constructionist epistemological position, recognising that knowledge is not an objective reality but constructed by participant experiences and social context [31]. This approach is relevant for the exploration of the complex contextual factors that shape directors' perspectives and decisions.

The authors bring a diverse range of expertise in health promotion research and evaluation, enabling the generation of rich insights through the co-construction of meaning from both health and early childhood education perspectives, ensuring relevance to practice.

### 2.2. Recruitment

Centre directors who were currently employed at long day care centres providing morning tea, lunch, and afternoon tea were eligible for the study. Directors were recruited from 783 centre-based services in Local Health Districts [8], located in areas with ethnically diverse populations. Purposive sampling was used to invite directors from centres engaged in the statewide *Munch & Move* initiative and hold knowledge on implementing healthy eating policies and practices. Health Promotion Service staff who support ECEC services to implement the *Munch & Move* initiative distributed recruitment material to directors through emails, e-newsletters, workshops, and a Facebook page. Data quality was reviewed

during data collection and recruitment stopped when adequate information power was reached [32]. Given the specificity of the research question, use of the established CFIR framework to guide semi-structured interview questions, and sample of experienced and qualified directors (Table 1), we determined the sample size of 12 participants provided sufficient insight to generate an in-depth understanding of the factors influencing healthy eating policy and practice implementation [27,32]. Participant characteristics are presented in Table 1.

**Table 1.** Demographic characteristics of participating directors and centre characteristics ($n$ = 12).

| Participant Characteristics | n (%) |
|---|---|
| Gender | |
| Female | 12 (100) |
| Age | |
| 18–29 years | 2 (17) |
| 30–39 years | 6 (50) |
| 40–49 years | 3 (25) |
| 50–59 years | 1 (8) |
| Highest level of education | |
| Degree (Bachelor, Masters, Doctorate) | 10 (83) |
| Graduate or Advanced Diploma | 2 (17) |
| Median years of experience in ECEC (Range) | 13.5 (5–28) |
| Country of birth | |
| Australia | 6 (50) |
| Other † | 6 (50) |
| **Centre characteristics** | **n (%)** |
| Number of children | |
| Range (n) | 35–98 |
| Average (n) | 62 |
| Service provider type | |
| For-profit | 9 (75) |
| Non-profit | 3 (25) |
| Food preparation | |
| All meals cooked on-site | 9 (75) |
| All meals are outsourced | 1 (8) |
| Mixed | 2 (17) |
| Socio-Economic Status (SEIFA 2021) ‡ | |
| Most disadvantaged | 0 (0) |
| Most advantaged | 12 (100) |

† China, Italy, Ireland, Mauritius, Pakistan, and the Philippines. ‡ ISRAD Quintile: Index of Relative Socio-economic Advantage and Disadvantage (ISRAD) provides a measure of advantage and disadvantage based on economic and social conditions, such as income and occupation, of people and households within a geographical area. A high score indicates a relative lack of disadvantage and greater advantage. Most disadvantaged = quintiles 1–3. Most advantaged = quintiles 4–5.

### 2.3. Data Collection

Semi-structured interviews were chosen for data collection to allow for the focused exploration of contextual factors within a limited timeframe, recognising the busy schedules of directors. A semi-structured interview guide was developed informed by the Consolidated Framework of Implementation Research (CFIR). The CFIR proposes a set of specific and detailed constructs in the inner setting domain to explain organisational factors and outer setting domain to explain the broader factors influenced by where the organisation is placed in the community, political, and economic environments [33]. The CFIR has

previously been used in the childcare and school setting to assess barriers and facilitators of healthy eating and obesity prevention programs [34–36].

The semi-structured interview guide consisted of seven open-ended questions to allow for open exploration of contextual factors, as well as prompts to explore factors outlined by CFIR (Table 2). The guide was pilot tested with an ECEC director not included in this sample before use to ensure questions were appropriate and relevant.

**Table 2.** Interview guide outlining the interview questions and associated Consolidated Framework for Implementation Research domain.

| CFIR Domain<br>Objective | Interview Questions |
|---|---|
| Context<br>To identify interventions currently being implemented | 1. Can you tell me about any food or nutrition policies/guidelines, practices or programmes that are currently provided at your service?<br>a What do you like?<br>b What do you dislike? |
| Innovation<br>To identify the components of the innovation that enable and/or inhibit implementation and sustainment of nutrition interventions. | 2. What features would you need to continue, improve, or discontinue?<br>Prompts:<br>- What would you change and why? What would you keep and why? |
| Inner setting<br>To identify the inner setting organisational barriers and enablers to implementation and sustainment of nutrition interventions. | 3. How does providing a nutrition policy, practice, or programme fit in with the priorities of your service?<br>Prompts:<br>- What are the values/beliefs around nutrition<br>4. Tell me about the resources available in your service for prioritising nutrition policy, practices and programmes.<br>Prompts:<br>- How does staffing influence how your service prioritises nutrition?<br>- How does cost/budget influence your service to prioritise nutrition?<br>- What are the workflows/processes that influence how you prioritise nutrition at your service.<br>- What are the communication strategies between management, educators, cooks, and families at your service to support healthy eating.?<br>5. What resources do you need to continue to provide it? |
| Outer setting<br>To identify the outer setting barriers and enablers to implementation and sustainment of nutrition interventions. | 6. Tell me about the factors outside the control of your service that influence your decision to provide a nutrition policy, practice, or programme?<br>Prompts:<br>- How is your decision influenced by external funding? (e.g., subsidies, re-imbursements, grants from government or non-government organisations or lack thereof)<br>- How is your decision influenced by external policies or guidelines?<br>- How is your decision influenced by national quality benchmarks/accreditation standards?<br>- How is your decision influenced by external entities (e.g., professional networks, government or academic organisations, community partners)?<br>7. What external support do you have/would you need to continue to provide it? |

All interviews were conducted by the first author (J.C.) at the ECEC centre where the directors were employed. Participants provided informed written and verbal consent prior to participation. The interviews were audio-recorded using Zoom software (version 6.4.12). Audio recordings were transcribed verbatim in Microsoft Word following the interviews. Interviews were conducted between December 2023 and April 2024. The duration of the interviews ranged from 20 to 67 min, with a mean of 35 min. Participants were provided with an AUD 30 gift voucher as reimbursement for their time.

### *2.4. Data Analysis*

Reflexive thematic analysis is well suited to a constructivist perspective, as it emphasises the role of the researcher in the co-construction of knowledge [37]. The flexibility of this approach allowed authors to use CFIR to deductively map contextual factors while inductively engaging with the data to generate themes relevant to the ECEC context. This allows for a structured approach to examine the inner and outer setting factors relevant to the study aim while also capturing how participants made sense of their experiences. The six-phase process, as described by Braun and Clarke, was used [38]. One data coder (J.C.) read through all the transcripts to become familiar with the data. Transcripts were first inductively coded by J.C. to allow codes and themes to emerge from the data. This was followed by a second level of coding guided by CFIR to articulate specific concepts. The codes from two transcripts were reviewed by a second coder (M.A.-F.). Discussion between the two data coders allowed for refinement and the addition of codes from a different perspective to provide a more nuanced interpretation of the data. One data coder (J.C.) then analysed the codes to generate candidate themes and sub-themes from patterns of meaning in the data. Candidate themes were refined by reviewing themes against coded data and re-reading the entire data set to ensure codes and themes fit. The final themes were organised and presented using the CFIR's inner and outer setting domains to support the interpretation in line with the study's aims and to highlight contextual factors influencing implementation. Themes were reviewed to define the central organising concepts and named. Data were managed and analysed using NVivo 14.

## 3. Results

Directors from twelve long day care centres participated in semi-structured interviews. Five key themes were developed relating to how directors described the influence of contextual factors on decisions to implement healthy eating policies and practices (Table 3).

**Table 3.** Overview of the themes describing contextual factors influencing directors' decisions to implement healthy eating policies and practices in centre-based early childhood education and care services.

| Themes | Sub-Themes | Overview |
|---|---|---|
| 1. Inner Setting factors | 1.1. Healthy eating "just happens"<br>1.2. Navigating competing priorities<br>1.3. Supportive work infrastructure | Inner Setting factors captures the barriers and enablers at the organisational level within ECEC services. Directors described implementation of healthy eating experiences was described as something that "just happens". Competing priorities for available resources such as funding and staff time was described as a barrier. Supportive work infrastructure was described as a facilitator. |
| 2. Outer Setting factors | 2.1. Satisfactory implementation support<br>2.2. Regulations vs. reality<br>2.3. Parent vs. partnership<br>2.4. Fragmented systems of support | Outer Setting factors captures the barriers and enablers at the system level across the ECEC sector. In the context of NSW, *Munch & Move* was identified as a key facilitator. External pressure from nutrition guidelines, the local attitudes of parents, and local funding conditions were identified as barriers. |

### *3.1. Theme 1: Inner Setting Factors*

#### 3.1.1. Healthy Eating "Just Happens"

Directors described shared values and goals around supporting children's needs and described providing healthy nutritious food as an "important part of our existence" (Participant 39). Directors recognised that many families were poor and may not be able to provide nutritious meals at home. As children were spending long hours in childcare, directors expressed fulfilment in providing nutritious food.

Directors' descriptions of their role in implementing healthy eating learning experiences were less consistent. Some explained that healthy eating was included as part of the

centre's programmed curriculum alongside science, maths, and literacy. For others, healthy eating learning experiences were seen as an important extracurricular, that is, "part of" but not a core aspect of the curriculum.

> "I would probably say that educators probably think more the core is more like social and emotional and things like that" (Participant 24, non-profit centre)

Directors described leveraging other learning opportunities to integrate healthy eating. For instance, participant 14 described implementing excursions to native gardens as an opportunity for nutrition education, to support the indigenous community, and talk about "caring for the earth as well". Directors also described other opportunities to integrate healthy eating while "also teaching them science" (Participant 12) and developing children's sensory perception and motor skills. Many described school readiness programs as a good opportunity to include healthy eating through lunchbox activities.

Directors often described healthy eating practices occurring organically and as needed. Directors felt that there were many opportunities for healthy eating learning experiences through discussions at mealtimes and daily conversations.

> "I wouldn't say there's a set time. There's obviously daily spontaneous conversations, but if it does come up [...] we'll plan a follow up experience." (Participant 19, for-profit centre)

Directors expressed that allowing staff to plan healthy eating learning experiences based on their interest increased staff motivation and facilitated implementation. Healthy eating learning experiences were also prompted by cultural celebrations and food-related events throughout the year or planned in response to educator, child, or family interest. Participant 24 compared the implementation of practices such as talking about healthy eating as something that "happens a lot" and "just happens" compared to physical activity, which needed to be "planned intentional like things that we focus on" to fulfill specific fundamental movement skill outcomes.

Directors expressed they were content with the way healthy eating policies and practices were currently being implemented and agreed informal practices were working well within their centres. When asked if any changes to internal practices were required, directors often expressed little need for change. Directors noted that, because their nutrition policy was "not very big" (Participant 24) and nutrition experiences occurred sporadically, they did not feel there were many restrictions or barriers to implementation.

> "So obviously we wouldn't be talking about nutritional planning, nutrition experiences every day or even so every week, it might just be sporadically, you know, throughout the year. So I don't feel that there's very many barriers." (Participant 19, for-profit centre)

#### 3.1.2. Navigating Competing Priorities

Directors articulated many complexities and competing priorities around food provision. Directors frequently commented on food allergies and anaphylaxis, suggesting this was at the forefront of planning and practice. Directors described challenges meeting nutrition guidelines while managing allergies. For example, participant 3 commented "the nutritional value of an egg is gone for the whole service, so it's very hard". Providing opportunities for children to make their own choices around food was frequently noted as an important value that directors described as a challenge to managing fussy eating. Other competing priorities described included minimising food wastage, ensuring quality of food, and food safety and hygiene.

Directors frequently commented on the competing demands for available financial resources, including the increasing costs of food, mandatory staff training requirements, and staff wages.

> "So the cost of living is rising too much, so that is one of the things that we are getting conscious of [...] We did have children with soy allergies, so definitely there is another type of bread for them. So again, it's cost, cost, cost added to it." (Participant 1, for-profit centre)

> "There's big pressure to bring costs down and wages are going up and there's staff in crisis at the moment [...] People are using staff from agencies which are costing a lot [...] and I think they're cutting corners a lot in terms of healthy eating and nutrition." (Participant 39, non-profit centre)

Directors from for-profit centres reflected that "it always comes down to money" (participant 25), and some explained costs were passed onto families through increased fees. Others applied for external grants, which enabled centres to prioritise healthy eating and support the implementation of interventions. However, securing external grant funding was challenging, as opportunities were scarce and a lot of paperwork was required.

Directors acknowledged staffing shortages across the ECEC industry; however, most directors described low staff turnover and dependable staff within their own centres. Directors noted when staff time was limited, it was usually allocated to primary responsibilities, including managing children for educators and food preparation for cooks, rather than the delivery of healthy eating practices. Some centres decided to use catering services to overcome these challenges and ensure children were provided with fresh and nutritious food even when staff were not available.

#### 3.1.3. Supportive Work Infrastructure

Directors who were confident in staff and their own capability often reported available resources. Directors described company support, including in-house dietitians, company-wide training for staff, and funding for mandatory training. For those part of a larger company, there were internal networking opportunities for directors and staff to support each other, such as WhatsApp group chats. Some also noted flexibility within the budget for food and flexibility to implement policy and practices according to local conditions. Some directors noted that the organisation of tasks and responsibilities within their team enabled learning experiences to be planned if an opportunity "pops up" (Participant 48). For example, chefs providing recipes or organising ingredients for educators to deliver cooking experiences.

For some, the ability to rely on informal practices was facilitated by local champions. Directors described that implementation of healthy eating practices was driven by passionate staff committed to providing high quality food and new learning experiences.

> "You couldn't replicate this everywhere. I think if you had high turnover and just say she was to retire and the person you replaced her with wasn't as passionate it could be a completely different." (Participant 39, non-profit centre)

Some directors noted staff were adaptable and flexible to fit changing needs and processes in place, such as regular team feedback to resolve issues. Some cited that their experience in the industry was a key facilitator to overcoming challenges, reflecting that "the only barrier is you know how much you push yourself" (Participant 14).

### *3.2. Outer Setting Factors*

#### 3.2.1. Satisfactory Implementation Support

Directors felt like they had access to support from a statewide government support service, *Munch & Move*, to implement policy or practices according to guidelines. Directors cited *Munch & Move* as the primary resource for healthy eating, including workshops for staff, written materials for parents, and resources to support staff to deliver learning experiences to children. Directors felt most supported for menu planning, noting the approval process and certificate as an incentive. Some directors noted that the government support service was more than just a resource for information, they felt that the relationship and trust with health promotion officers was a facilitator for implementation. One director expressed that they felt more comfortable reaching out to *Munch & Move* than approaching their company head office for support.

> "So it's not just sending our stuff in the mail. Like we have a great connection with them, so it's really good trust." (Participant 14, for-profit centre)

#### 3.2.2. Regulations vs. Reality

Some directors expressed that external quality standards and guidelines related to food and nutrition were necessary to safeguard the ECEC industry and ensure high quality care. For others, policies and guidelines were an obligation. Directors stated they had a duty of care to children and families to follow them and "tick all of those boxes" (Participant 19).

External nutrition policies and guidelines were seen as unrealistic. Some directors noted that the requirements for red meat did not align with family preferences and some noted that the requirements for vegetables were excessive, leading to food wastage and higher food costs. Some directors also felt that the requirements for healthier alternatives were too costly.

> "And we've tried to take this suggestion on board, and often it leads to a lot of food wastage [...] Even though we sat with children and role model and involve them in the process." (Participant 12, non-profit centre)

#### 3.2.3. Parent vs. Partnership

Directors expressed concerns about the differences in practices between the home and the ECEC food environment and how this could potentially "confuse children" (Participant 16). Directors described discrepancies being attributed to a lack of parental nutrition knowledge, differences in cultural values, or, for others, directors noted families were poor and tight on money.

Directors expressed communication with parents was important for building partnerships between ECEC and families. Directors also noted the importance and responsibility of ECECs to support families with healthy eating practices at home. This included documenting healthy eating learning experiences and sharing with parents, organising parent evenings, distributing newsletters and information sheets, and sharing links to workshops. However, some directors reflected there was little engagement from parents and, as such, felt limited in what they could do to support families.

> "Yes, but we need to honour whatever the parents decide. And that is a bit of a barrier because we can try and talk to them, but at the end of the day they can make their choices for their child." (Participant 22, for-profit centre)

Directors also described facing parental pressure to manage fussy eating behaviours and cater to family preferences. Some directors felt that they had to honour parents' wishes despite going against recommendations and guidelines, creating tension between trying to please parents and meeting policies and guidelines.

> "We had a complaint where they said nothing was homemade and then we changed the menu with all homemade and then we check [...] with *Munch & Move*, they said you can't have everything baked [...] I'm like, Oh my God, it's hard to like please everybody [...] but you know, we're not the Hilton and we're not going to be providing like, gourmet every day." (Participant 3, for-profit centre)

Directors expressed the need for more information and resources to support families, particularly for first time parents. Some suggested more support is needed to implement "hands-on" healthy eating interventions that involve the home environment, such as an app or workshops for families. Directors noted there was an existing relationship with the local council and reflected on the successful implementation of environmental sustainability programs. Following the success of these interventions, directors recommended that aspects of healthy eating and nutrition should be incorporated.

#### 3.2.4. Fragmented Systems of Support

Systems to support implementation of healthy eating policy and practice were seen as inadequate to support the ECEC sector. Directors expressed that they were interested in more information and new ideas for how to implement healthy eating policies and practices, but noted it was challenging to stay up to date with available resources. Directors described resources as scattered and recommended a directory or service to support directors in locating current resources. Directors noted that they often rely on their own research and internal support to stay up to date with new information, resources, and funding opportunities.

> "It's very time consuming [...] it's Googling, it's looking for them [...] But for something like that I wouldn't even know where to look. So, I have support with the parent management committee to sometimes help me lock down grants." (Participant 39, non-profit centre)

Directors felt that the National Quality Standards were "not extremely specific like NSW Health" and centres could "interpret them the way that they wish" (Participant 19). However, there was tension between the ideal of implementing more specific guidelines for consistency across the ECEC sector and the reality of implementation. Directors reflected on the lack of external partnerships and connections with the community. Directors also expressed concerns that new staff had inadequate nutrition education during their early childhood educator training. Directors described limited ongoing professional development opportunities and recommended funding for online modules or workshops to support staff. Furthermore, directors felt there was a lack of funding and policy to support the challenges faced by the ECEC industry, such as staff shortages.

> "We already have enough guidelines, enough regulations, we just don't have the funding, or the education for it. So, yeah, those are the big issues because like, yes, you can add the regulation, but that's not going to change anything." (Participant 22, for-profit centre)

## 4. Discussion

The current study identified the contextual factors influencing ECEC directors' decisions to implement healthy eating policies and practices. Directors articulating implementation success described supportive inner setting factors, including a strong culture of shared values and goals to support children's growth and development and work infrastructure to organise tasks and responsibilities for staff, as well as having a local champion to lead the implementation. However, directors noted that competing demands on resources, such

as centre funding and staff time, were a key barrier. Directors also acknowledged outer setting partnerships with Local Health District services to support the implementation of healthy eating guidelines. Directors often described outer setting factors inhibiting implementation success, including lack of external partnerships with the community, unrealistic guidelines, parental pressure, and inconsistent practices at home. Directors expressed that local conditions were not supportive, citing workforce and funding issues across the ECEC sector. The sustained implementation of healthy eating policy and practices depends on key outer contextual factors, including having a policy or guideline from a governing body, alignment with the broader community, such as parents, and external partnerships [39].

Within the inner setting, directors described having flexibility in their food budgets and the ability to pass on costs to families through fee increases, enabling the provision of nutritious meals. Although directors described a complex environment of competing demands for available resources that impacts on the implementation of healthy eating policies and practices, participants noted a supportive work infrastructure, such as provider support for in-house dietitians and training, which enables healthy eating learning experiences to "just happen". These experiences may be specific to centres in advantaged areas represented in this sample and may not reflect those of centres in disadvantaged areas. In contrast, centres located in disadvantaged areas are less likely to provide meals, and when meals are offered, their provision is not associated with fee increases, as parents' ability to pay constrains pricing, thereby limiting food budgets and flexibility [40]. These centres may also experience greater job demands to meet the needs of children and families experiencing disadvantages [41]. A previous study found that implementation was less likely if healthy eating was perceived as less important compared to other priorities [36]. Opportunities to use programs to meet multiple curriculum requirements and the ability for these programs to "fit" within existing workflows and systems can facilitate the implementation and sustainability of nutrition and physical activity interventions in the ECEC setting [42]. Given competing demands, strengthening connections between healthy eating and the learning outcomes at the forefront of planning and practice through multisectorial partnerships may better align with director priorities and support implementation.

Networks and partnerships with external organisations have been identified as important facilitators to supplement available resources and provide partners for the implementation of healthy eating activities [36,42]. In the current study, partnership with a statewide government service and targeted healthy eating support were key facilitators, aligning with the existing literature and highlighting the importance of implementation support in enhancing policy and practice adoption in ECEC settings [13]. However, directors expressed a need for a coordinated system to access information and more community partnerships, suggesting greater input from the local council. Local councils are well placed to provide support to improve implementation of healthy eating interventions in ECECs given their role in providing goods and services to their communities, local planning, and implementing local food system policies [43]. Multisectoral partnerships between local council, local health services, and ECEC regulatory authorities could provide a more coordinated approach to support directors in their role to implement healthy eating policies and practices [10].

Previous research suggests that ECEC centres are more likely to implement healthy eating interventions when they have parental support [36]. However, similar to the findings of this study, others report that parental disengagement and inconsistencies between home and ECEC settings are common challenges [29,44]. Effective workflow designs that promote regular communication and collaboration with parents are key to addressing disengagement [42,45]. Inclusion of resources to support staff in communicating and collaborating with parents through existing ECEC nutrition support services and programs

can improve parent partnerships [46]. To support this, existing programs like *Munch & Move* (NSW) and Healthy Eating Advisory Service (Victoria) could be expanded to include family engagement components. Directors in this study recommended home-based learning activities, workshops, and a digital tool such as an app for families. Policy incentives could encourage ECEC services to promote parent engagement and improve healthy behaviours across home and ECEC settings. For example, in the United States, the Child and Adult Care Food Program (CACFP) is a federally funded initiative that ties funding for meal subsidies with standards that require ECEC services to communicate with parents about child nutrition [47].

Consistent with previous research, directors described many informal opportunities to implement healthy eating practices [29]. However, studies conducted in NSW and Victoria, Australia, suggest current healthy eating environments and practices do not align with best practice guidelines [12,48]. Directors may not always express the need for change if not aware of how and why healthy eating practices should be implemented [44]. Additionally, weak nutrition policies that are not tailored to centres and lack adequate detail may result in poor implementation of healthy eating practices [29,48]. It would be in the best interests of children if there was a national agreement to set clear objectives regarding food provision and healthy food environment outcomes to ensure consistent interpretation across the ECEC sector. However, the findings from this study suggest further investment in resourcing is needed to support the implementation of stronger nutrition standards. For example, in the United States, ECEC centres receiving CACFP subsidies for serving healthy meals reported fewer barriers to implementing new healthy eating policies [49]. Similar to CACFP, introducing a funding model in Australia that requires centres to meet nutrition guidelines as a condition of receiving support may improve compliance with nutrition standards and promote healthier food environments.

In this study, state guidelines were perceived as unrealistic by the directors, failing to acknowledge the competing demands and complexities of the setting. While many directors were "lucky" with their staff, directors expressed the need to fix underlying issues with the ECEC workforce, such as poor staff retention and insufficient nutrition knowledge, before making changes to the rules and regulations. Staff shortages and turnover in the Australian ECEC context have been well described and attributed to high demand, low staff wages, poor work conditions, and lack of recognition [41]. Dependable staff have been found to be important facilitators in this study and others [42], emphasising the need for long-term investments from national and subnational budgets to ensure a skilled ECEC workforce that meets the level of demand [10]. Nutrition training should be standardised and mandated for all ECEC staff by embedding comprehensive nutrition and responsive feeding content in early childhood education qualifications and providing ECEC specific nutrition training for cooks.

Despite the "workforce challenges", staffing was rarely identified as a barrier in this study, possibly reflecting that a skewed sample was recruited. This may be because directors experiencing resource constraints likely lack the time or capacity to participate. Additionally, while recruitment included directors from socio-economically diverse areas, all participants who volunteered to participate were from advantaged areas, which may limit transferability of the findings to ECEC services in disadvantaged communities. These settings are often more likely to experience implementation challenges such as resource constraints [40]. Further research is needed in disadvantaged communities to better understand the contextual barriers and enablers that shape implementation in these settings. Although all participants recruited were female, this reflects the gender composition of the Australian workforce in this sector. In 2024, the ECEC National Workforce Census reported that 91% of the ECEC workforce was female [50]. Although the findings were

similar to those described in recent studies from other jurisdictions within Australia [24,29], we acknowledge this sample may not capture all experiences. However, the findings offer insights from directors who are engaged with and interested in nutrition and food practices, which can provide valuable information that those indifferent to the topic may overlook. This study addresses important gaps in the literature, as the majority of studies examining barriers and facilitators to the implementation of nutrition in the ECEC setting focus on describing the inner setting factors and lack theoretical guidance, with only 28% of studies using theories, models, or frameworks to guide evaluations [42]. A strength of this study is that it used both an inductive approach to allow for engagement with the rich data and a deductive approach informed by the CFIR to systematically identify inner and outer setting factors. This approach generates practical insights to inform the development of policy and practice recommendations that more accurately reflect the real-world challenges faced by ECEC settings. Further research to understand the unique outer contextual factors experienced by disadvantaged populations across Australia and other ECEC centre types such as family day care is recommended to inform policy and practice.

## 5. Conclusions

This study provides a greater understanding of contextual factors influencing directors' decisions to implement healthy eating policies and practices in the ECEC setting. Inner setting contextual factors, including alignment of goals and values, fit within work infrastructure, and implementation leads, were identified as facilitators. External partnership with government support services was identified as an enabler within the context of NSW, Australia. The study identified the need for further support to navigate the outer setting contextual factors impeding implementation. The ECEC setting may benefit from strengthening community partnerships with the local council, expanding government-funded implementation support to include family engagement components, investment in the workforce through standardised and mandated nutrition training for all staff, and provision of conditional funding support that encourages ECEC services to meet nutrition standards. A combination of "upstream" national policy actions to improve the outer contextual factors and "downstream" approaches that focus on the inner setting factors is recommended.

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**Informed Consent Statement:** Written informed consent was obtained from all participants involved in the study.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author due to ethical restrictions.

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## Abbreviations

The following abbreviations are used in this manuscript:

| | |
|---|---|
| CFIR | Consolidated Framework for Implementation Research |
| ECEC | Early Childhood Education and Care |
| NSW | New South Wales |

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**Appendix 3.4** Publication resulting from Chapter Five

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RESEARCH ARTICLE OPEN ACCESS

# Beyond Local Champions: Contextual Factors Shaping the Implementation of Healthy Eating Interventions in Centre-Based Care – A Qualitative Study With Educators and Cooks

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## ABSTRACT

**Issue Addressed:** The early childhood education and care (ECEC) setting provides a critical opportunity to reach young children and families to support optimal nutrition and development. Despite the abundance of healthy eating interventions delivered in this setting, the most effective ways to improve children's diets remain unclear. These efforts are hindered by our limited understanding of the complex set of factors that influence the successful implementation of healthy eating interventions. This study aims to explore early childhood educator and cooks' experiences of the contextual factors influencing the implementation of healthy eating policies and practices.

**Methods:** A qualitative study using semi-structured interviews was conducted with 10 educators and cooks from New South Wales, Australia. The Consolidated Framework of Implementation Research was used to guide data collection. Data were analysed using reflexive thematic analysis.

**Results:** Educators and cooks expressed commitment to implementing healthy eating policies and described support from directors and local health services. However, ECEC sector conditions inhibited implementation success. Barriers to implementation included inadequate collaboration between management, educators, cooks and parents; limited opportunities for partnerships and networking within the ECEC sector and beyond; and insufficient nutrition education and training.

**Conclusions:** Addressing broader systems-level factors by strengthening work infrastructure, partnerships, and nutrition education and training opportunities is necessary to improve the implementation success of healthy eating policies and practices in the ECEC sector.

**So What?** Findings can inform policymakers to consider barriers faced by ECEC staff in implementing healthy eating interventions.

## 1 | Introduction

Early childhood education and care (ECEC) is a powerful setting for promoting healthy development and eating habits in early years. ECEC attendance is associated with better language skills, academic achievement and reduced risk of poverty in adulthood [1, 2]. Following major policy reforms implemented in 2008 to increase access to preschool programmes, the number of Australian children attending preschool, including programmes provided by centre-based long day care, has grown [3]. In 2024, almost 60% of Australian children attended centre-based day care and spent on average 27 h in care per week [4]. Given the number of children in attendance and long hours in care, centre-based ECEC services provide opportunities to improve children's eating behaviours and diets.

The majority of studies investigating the effectiveness of interventions to optimise children's diets have been conducted in the ECEC setting [5]. However, the effectiveness of ECEC-based healthy eating interventions remains unclear [6]. Interventions show favourable results for fruit intake, but there appears to be little to no effect on the consumption of vegetables, energy-dense nutrient-poor foods and sugar-sweetened beverages [6]. Support strategies such as providing educational materials, audit and feedback, incentives, reminders and tailored advice may improve intervention implementation, but these strategies did not translate to better child dietary outcomes [7]. Implementation issues can attenuate the potential benefits of evidence-based healthy eating interventions on children's dietary outcomes in the real world [8].

In Australia, the implementation of healthy eating practices in the ECEC setting is varied and some practices remain poorly implemented [9]. Research suggests that long day care centres providing food on site are not meeting menu planning guidelines [10, 11]. The National Quality Standards (NQS) set quality benchmarks which state that healthy eating be "promoted and appropriate" for children [12]. In New South Wales (NSW), the state-funded *Munch & Move* initiative is delivered by local government health services to support implementation of state-specific best practice guidelines on healthy eating and nutrition for the ECEC setting [13]. However, food provision guidelines vary across each state and territory and only three out of eight jurisdictions provide state-funded programmes [14]. As such, there have been calls for a national coordinated approach to provide support to ECEC services to implement healthy eating policies and practices [14]. Given the differences in guidelines, support and resources, it is important to gain a systems-level understanding of how the various factors interact to influence implementation across jurisdictions within Australia.

The ECEC setting is shaped by a complex set of influences, many of which pose challenges to implementing and sustaining healthy eating policies and practices. A substantial body of research has examined the barriers and enablers to implementing healthy eating policies and practices in the ECEC setting [15]. Qualitative studies to investigate the barriers and enablers to a health-promoting food environment [16], menu planning guideline implementation [17] and factors influencing food service provision [18] have been previously conducted in Queensland, Victoria and South Australia, respectively. In NSW, factors influencing the implementation of healthy eating policies and practices have been previously explored; however, these studies use a deductive quantitative approach which may limit insight into specific barriers related to implementation and overlook important factors [19–21]. Notably, most of these studies have applied the Theoretical Domains Framework which focuses on describing 'inner setting' factors such as knowledge, skills and beliefs at the individual level, social influences at the interpersonal level, and environmental context and resources at the organisational level.

Our understanding of the 'outer setting' such as the sociocultural values and economic, environmental and political conditions within the broader systems in which ECEC services operate remains limited. Addressing these broader influences is essential for the development of effective, system-level policy interventions. For example, in the United States, the Child and Adult Care Food Program reduces financial barriers by providing free or subsidised meals to children in low-income communities, with participating centres reporting fewer implementation challenges compared to non-participating centres [22]. Given that health and nutrition support in Australia is state-based, and the level of support varies across states, it is important to understand contextual factors within each state. In NSW, where the state-funded healthy eating programme exists, further qualitative research into system-level influences on policy implementation could also inform support strategies in the ECEC setting across other jurisdictions.

Within the ECEC setting, ECEC staff play a critical role in providing a safe environment to meet children's health and nutritional needs and nurture healthy eating habits. Particularly important are early childhood educators and cooks. Educators can shape the dietary behaviours of young children through modelling healthy eating, providing nutrition education and reinforcing positive behaviours during mealtimes [23] whilst ECEC cooks or chefs play an integral part in the planning and preparation of meals, as well as exposing children to food through health-promoting menus [18]. Australian research has predominantly focused on directors and cooks, with limited attention to educators' perspectives. Exploring and comparing the experiences of both educators and cooks is integral to understanding the contextual factors influencing the delivery of healthy eating policies and practices given their different roles. This study aims to add to the body of evidence and examine the inner and outer setting factors influencing the implementation of healthy eating policies and practices from the perspectives of early childhood educators and cooks in NSW, Australia.

## 2 | Methods

The researchers followed the Standards for Reporting Qualitative Research (SRQR) reporting guideline [24]. This study was approved by the Sydney Local Health District Human Research Ethics Committee (Project Number X23-0379).

### 2.1 | Qualitative Approach and Paradigm

This study is underpinned by an interpretivist or social constructivist paradigm assuming that reality is multiple and subjective, and meaning is shaped by past experiences and social context [25, 26]. A qualitative descriptive approach allowed authors to explore and present findings in a way that closely reflects the

multiple and subjective experiences of participants [27]. This approach is relevant to constructing meaningful and nuanced accounts of how context influences experiences of educators and cooks and better understand the complexities of implementing healthy eating policies and practices unique to the ECEC setting.

Four authors are experienced in research into nutrition and early childcare settings. As practitioners with extensive experience in the early childcare sector, authors J.C. and A.H.-P. bring nuanced insights and understanding of the childcare environments. Authors P.P. and M.A.-F. have considerable experience conducting mixed-methods research involving qualitative study design and analysis. Author D.R. is an experienced researcher in the ecology of nutrition. Our complementary perspectives and experiences enhanced the study's methodology and ensured transparency, as we were cognisant and reflective of our respective experiences in data collection, analysis and interpretation.

### 2.2 | Recruitment

Early childhood educators and cooks currently employed at a centre-based ECEC service providing food to children were eligible to participate. As we were interested in exploring the different experiences with external factors such as local community conditions, we used purposeful sampling to recruit participants from ECEC services located across central and south eastern Sydney where there are ethnically diverse communities. Educators and cooks were invited to participate by representatives from Local Health District Health Promotion Services who have an existing relationship with ECEC services through the *Munch & Move* initiative. Recruitment materials including a study flyer and information about the risks and benefits associated with the study were distributed by email, newsletters, workshops and a Facebook page. Those interested were able to voluntarily participate by following a link from the flyer to an online survey to collect informed written consent and demographic data (Appendix A).

### 2.3 | Data Collection

Data were collected using semi-structured interviews, which allowed for guided exploration of participant experiences within the allocated timeframe recognising that educators and cooks are time poor. As it has been previously reported that there are workforce challenges, staff shortages and poor work conditions [28], individual interviews allowed for confidential discussion of workplace relationships and barriers. The interview guide (Appendix B) contained seven open-ended questions and additional prompts based on the Consolidated Framework of Implementation Research (CFIR). The CFIR describes factors influencing implementation across five domains: Innovation, Outer Setting, Inner Setting, Individuals and Implementation Process [29]. The interview focused on exploring participant experiences of implementing the *Innovation* or healthy eating policies and programmes, and how implementation is influenced by *Inner Setting* and *Outer Setting* domains to allow for in-depth exploration of contextual factors most relevant to addressing the study aims. The interview guide was piloted with an educator and cook not included in this sample to ensure clarity and relevance of the questions. The number of educators and cooks interviewed was guided by the information power principle whereby the depth and richness of data was achieved amongst a targeted sample [30, 31]. Participants were recruited with support from health promotion services, resulting in a homogenous sample of cooks and educators who were more involved in nutrition and healthy eating, thus offering insights relevant to the study aims. The study had a specific aim and was informed by the established CFIR framework. Based on these factors, the sample size of 12 participants was deemed to provide sufficient information power to address the study aims. Participants were interviewed at the ECEC service where they were employed by the first author (J.C.). Verbal consent was obtained prior to collecting audio recording of the interviews using Zoom software. Audio recordings were transcribed verbatim using Microsoft Word. Participants received an AUD $30 gift voucher following the interviews to reimburse them for their time. Ten interviews with four educators and six cooks were conducted between December 2023 and April 2024. Interviews ranged from 18 to 70 min, with a mean of 36 min.

### 2.4 | Data Analysis

Reflexive thematic analysis was selected because it is suited to our theoretical orientation, valuing meaning produced from participants subjective experiences and researchers perspectives and assumptions [32]. The theoretical flexibility of reflexive thematic analysis also allowed for authors to bring in constructs from the CFIR to provide a lens to code and understand patterns of meaning [33]. Data were analysed by the first author (J.C.) using Braun and Clarke's six-phase approach [34]. Transcripts were first inductively open coded to allow themes to emerge from the data. This was followed by a second round of coding using a deductive approach guided by the CFIR to articulate specific constructs and generate initial themes. J.C. continued to review and refine the themes until clear central organising concepts were identified, ensuring a fit with the data set. To ensure research quality, each stage of the analytic process was documented and J.C. reflected on the values and perspectives as a dietitian and researcher throughout the process. Data were managed using Nvivo 14.

## 3 | Results

Participant and centre characteristics are presented in Table 1.

### 3.1 | Theme 1: Inner Setting Factors Fostering Local Champions

*Inner setting factors fostering local champions* capture participants reflections of the factors driving implementation of healthy eating practices. Participants articulated reliance on personal motivations, interests and experiences to fulfil their roles around food and nutrition. Outside of their individual attributes, participants described supportive relationships in the inner setting, which contributed to their ability to act with agency and feel empowered in their roles.

**TABLE 1** | Demographic characteristics of participating educators ($n = 4$) and cooks ($n = 6$) and centre characteristics ($n = 10$).

| | *n* (%) |
|---|---|
| Participant characteristics | |
| Gender | |
| Female | 9 (90.0) |
| Male | 1 (10.0) |
| Age | |
| 30–39 years | 4 (40.0) |
| 40–49 years | 4 (40.0) |
| 50–59 years | 1 (10.0) |
| 60–69 years | 1 (10.0) |
| Education level | |
| Secondary education | 1 (10.0) |
| Certificate I–IV | 3 (30.0) |
| Graduate or advanced diploma | 3 (30.0) |
| Degree (bachelor, masters, doctorate) | 3 (30.0) |
| Median years of experience in ECEC (range) | 9 (4–25) |
| Country of birth | |
| Australia | 2 (20.0) |
| Other[a] | 8 (80.0) |
| Centre characteristics | |
| Mean number of children (range) | 63 (30–102) |
| Service provider type | |
| For-profit | 2 (20.0) |
| Non-profit | 8 (80.0) |
| Food preparation | |
| All meals cooked on site | 10 (100.0) |
| Socio-economic status (SEIFA 2021)[b] | |
| Most disadvantaged (quintiles 1–3) | 0 (0.0) |
| Most advantaged (quintiles 4 and 5) | 10 (100.0) |

[a]Argentina, Brazil, India, Indonesia, Netherlands, Northern Ireland, Taiwan, and United States of America.
[b]Socio-Economic Indexes for Areas (SEIFA) IRSAD quintiles: Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) provides a measure of advantage and disadvantage based on economic and social conditions, such as income and occupation of people and households within a geographical area. A high score indicates a relative lack of disadvantage and greater advantage. Most disadvantaged = quintiles 1–3. Most advantaged = quintiles 4 and 5.

#### 3.1.1 | You Only Limit Yourself

Whilst acknowledging challenges, both educators and cooks described being confident in their competence, knowledge and skills required to fulfil their role and implement healthy eating practices. This was evident in the way participants described opportunities to innovate. For example, one educator commented 'we are not hesitant to try something different' (participant 27). Participants situated their experience as different from others suggesting this is not the case across the sector.

> I'm special. I'm different, you know. I can do it. I can do a very good meal in one hour, but that's me, [other cooks] they can't. (Participant 32, cook)

> I think if you probably talk to other chefs there would be a lot more barriers. Just because this comes like second nature to me. (Participant 18, cook)

Some participants attributed their capability to their years of experience in the industry and previous roles in commercial kitchens which equipped them with practical knowledge and skills to adapt in the ECEC setting. Participants also described their own motivation to challenge themselves, articulating a commitment to continuous improvement and learning. One cook commented 'I think you only limit yourself' (Participant 20).

> I love to do lots of research and I like to learn new things. And yeah, I do a lot of it on my own. (Participant 11, cook)

Additionally, participants described a sense of personal fulfilment in their roles, especially in fostering children's healthy eating habits and supporting families to manage fussy eating. One cook commented that the sense of fulfilment from educating and exposing children to new foods was very important, otherwise 'it becomes just a job, and you just become a robot [...] it's very satisfying to see [the food] not coming back' (Participant 40). Participants highlighted the importance of connecting with children and families and helping families who might not have the knowledge around nutrition and healthy eating. When asked about incentives, participants frequently described seeing changes in children's eating habits as a key motivating factor to continue to implement healthy eating practices.

> I'm here because I would like to make a difference in children's lives [...] And it's also building the relationships with the kids and the parents. [My reward] doesn't come from the company. (Participant 50, cook/chef)

#### 3.1.2 | You Are a Role Model for the Job

Educators frequently described their own personal interest in healthy eating and nutrition as a facilitator to advocate for and implement healthy eating policies and practices. For instance, centres relied on educators whose passion or 'area of expertise' was food and nutrition to plan and run cooking experiences with the children. One participant highlighted the importance of training opportunities in reinforcing staff interest to implement healthy eating practices and share this knowledge with other staff.

> I attended a lot of [Munch & Move] training [...] it confirms my own personal value and philosophy that 'Oh yes, this is very important, this is what we need to do with the children'. (Participant 44, educator)

Educators also discussed being 'a role model for the job' and reflected on their own personal eating habits influencing delivery of healthy eating practices. For example, one educator commented that being a 'healthy eater' allowed them to better role model healthy eating habits during mealtimes. Participants reflected that their personal experiences provided credibility when supporting families. One participant likened the situation to being a personal trainer, commenting if the personal trainer was not physically active themselves, they would not have any customers. Another participant reflected that her own personal experience as a mother of five was a 'selling point to families' (Participant 52, educator). Participants noted unhealthy habits in educators around them and attributed this to educators being 'mentally really exhausted when [they are] working with the children the whole day' (Participant 17, educator).

#### 3.1.3 | Supportive Leadership

In addition to their own capability, motivation and interest, participants described supportive relationships and high-quality communication within their organisation to facilitate implementation of healthy eating policies and practices. Participants emphasised the importance of trust from directors and autonomy to be creative as facilitators to fulfilling their roles.

> I have a great director, that literally lets me be creative and do what I need. I have access to my own [...] iPad in the kitchen. So yeah, I can always look up new inventive things, I've got the teacher support. We've got a lot of parents' support. (Participant 18, cook/chef)

Participants also identified flexibility around budget from centre directors as an important facilitator.

> [The director] always told me that there's no budget for food we can buy. So, I like the freedom in everything I get here and that has boost up my confidence as well. (Participant 27, educator)

Furthermore, centre routines around mealtimes and programming time, was described as pivotal for creating a supportive environment for participants to deliver healthy eating practices.

### 3.2 | Theme 2: Outer Setting Sector Challenges

Whilst participants articulated feeling capable and motivated to deliver healthy eating practices, implementation was contingent on factors outside of their control. *Outer setting sector challenges* captures the tensions articulated by participants between commitment to implement healthy eating policies and practices under ideal conditions and complexities in their daily reality. Participants reflected on goals to improve implementation of healthy eating practices but described uncertainty around when goals could be achieved. Implementation was dependent on the right conditions and when opportunities aligned. Participants described staff shortages, being too busy and not having enough time to plan fun ways of engaging children, lack of ideas and prepared resources, and waiting to 'get back into routine' (Participants 17 and 20). This idea is articulated by participant 11 who described implementing cooking activities with children 'in the beginning of the year when things were a little bit better'.

#### 3.2.1 | Out of Our Control

Implementation of healthy eating practices relied on certain individuals with interest or expertise to improve or implement, rather than a collaborative effort. There was a tension in beliefs around what educators, cooks and families should be doing and whose responsibility it was to engage children. Some educators felt that the cooks should improve the menu, such as including more variety of foods to encourage children to eat. On the other hand, cooks described their role as limited to providing food and educators to motivate children to eat. Some cooks articulated that it should be the responsibility of an external expert to ensure that the menu meets nutritional requirements.

> I don't know how the educators they feed the kids, but for me it's their job to motivate the kid to eat it. (Participant 32, cook)

Participants commented on the importance of collaboration to support implementation of healthy eating practices. For instance, collaboration between educators to plan cooking experiences and cooks to organise materials to support with delivery. However, participants articulated that the lack of communication and support from other staff was a limitation to supporting children's healthy eating behaviours.

> I think another barrier is the people you work with, if we all have the same mindset about healthy eating, we could come up with a project together to do with the children. (Participant 17, educator)

Educators expressed that they can only guide families and that ultimately, it's up to children and families' choices. Some articulated that implementing healthy eating practices were lower on their priorities because it was up to children to decide what and how much to eat. Educators were happy to support families with healthy eating when asked by families but did not feel comfortable initiating the conversation. Educators expressed they didn't want to appear to question their parenting and offend families.

> So I think parents have the prime most responsibility. We can guide them, we can tell them. But at the end

> of the day, it's their children, their choice. (Participant 27, educator)

#### 3.2.2 | Outer Setting Partnerships

Participants described partnership and trust from parents as a crucial factor. One educator noted that 'the collaboration with the family is the biggest thing and maybe the only one externally. (Participant 44, educator).

Participants described reaching out to government health service support, *Munch & Move*, for free training to support them to deliver healthy eating policies and practices. This included working with *Munch & Move* to manage and support families with fussy eating, menu planning and training. However, beyond partnerships with families and *Munch & Move*, educators and cooks reflected that there were limited opportunities for partnerships outside of the ECEC setting, particularly with external organisations in the community.

> I'm just thinking maybe childcare should get linked up to NSW Health services. Do some programmes where they come into childcare centres...I think it's very good if we all can be included, educators get a chance, parents get a chance. (Participant 27, educator)

Cooks reflected that they felt alone in their role, due to a lack of opportunities to network and communicate with other cooks in the sector. Participants reflected there were no active support networks and relied on their own peer networks.

> The only people that I work with is Munch and Move. Cooks in centres, they should be supported a little bit more but sadly [...] it's just once you're once you're in, it's up to you to make that leg work. (Participant 11, cook)

Cooks also frequently emphasised the importance of having a reliable food supply. Cooks commented that access to multiple local suppliers and pre-cut meats and bigger cans to maximise time efficiency was an important factor to support their role.

#### 3.2.3 | Inadequate Industry Support

Cooks articulated that they did not feel as though their challenges were understood by service providers or by the ECEC sector. Cooks described instances where service providers failed to consider the practicalities of food preparation in the ECEC setting, leading to conflicting priorities and increased pressure. Some attributed this to poor communication and a lack of opportunities to voice their perspectives.

> Look, I feel like management does a lot of talking. I feel like it should be a bit more about how we do things, how the kitchens run, like what our menus are, what our struggles are, you know, like try to keep on budget, where can we get the better option? (Participant 18, cook)

Participants also perceived guidelines were not practical for the demands of their role. Participants felt that guidelines did not consider available resources including time and space, food allergies, children's taste preferences, and fussy eaters, and felt guidelines were too restrictive or boring.

Participants described being thrown in at the deep end when starting their role and expected to support healthy eating without adequate support and guidance, given the lack of nutrition education received during their training. Participant 11 likened their experience to being 'thrown into the middle of the ocean. You must swim. You might drown. Good luck to you'. Some cooks expressed concern about the quality of new educators, noting the lack of experience, confidence and knowledge.

> But also to the fact that when I entered the company I had no support to start with, they had nothing to offer in terms of the network in terms of previous menus. All they said is here's your password, you need to order from Coles. Here is your budget $800, go for it. (Participant 50, cook)

Participants commented that there was inadequate support and guidance from providers. Beyond that there were also limited opportunities for training to upskill themselves within the workplace setting. Participants often relied on upskilling themselves by paying for their own courses and doing their own research through the internet or Facebook groups for cooks. Participant 32 compared ECEC with the aged care sector to highlight the lack of training and professional development opportunities in the ECEC sector.

> Well, I think when I was in aged care, just comparing environments. We had lots of training like we had courses like we had to do refresh courses every six months and all this. Was it a little bit overwhelming, yes. But like now in childcare, there's none. (Participant 32, cook)

Whilst some participants felt fulfilled supporting healthy eating and motivated to do their own research as explored in Theme 1, for other participants, competing demands and the lack of support meant that professional development around healthy eating was not prioritised in planning and practice. Furthermore, participants described not knowing where to go to access information and professional development opportunities, again relying on their own research, highlighting the lack of sector support.

> [...] if I could get it, I would. I've never thought about it and how to even go about it. I should probably go and google it. (Participant 52, educator)

Participants articulated unrealistic expectations from centres/providers to complete administrative, planning, and quality improvement tasks on top of their primary responsibilities.

> I think like the factor to that is a more like a like the whole bigger picture with the early childhood. Sometimes you always find time constraint everywhere like we have so many things to do but there's such little time. (Participant 44, educator)

Participants described doing their own research in their own time, which was not recognised by the centre. Participant 50 described feeling undervalued and commented on the need for more compensation for their responsibilities.

> They should either one, if they don't want to pay cooks to do menus they create menu, get somebody to create menus for them and then just distribute it them quarterly [...] Or pay the cooks quarterly. If educators are getting paid to plan activities for children [...] it just seems logical that of course the cook needs time to plan a menu. (Participant 50, cook)

#### 3.2.4 | Inconsistent Practices

Participants expressed frustrations at the inconsistencies in practices between the home and ECEC setting and between ECEC services. Some participants described unhealthy home environments and practices that undermined the efforts at ECEC. Participants attributed this to a lack of support for families, such as inadequate nutrition education and financial resources for some.

> And then it also needs to be backed up with the support at home. What I find is a lot of families are they pick the kids up and they have chocolates in the car for them, which is [against] everything we're teaching them to eat healthy [...] you have to have the support all the way through or it just doesn't work, or everything you've done up until they get to the age of three starts to fall apart. (Participant 50, cook)

Cooks noted differences in guidelines between jurisdictions within Australia, noting NSW guidelines felt more restrictive. Participants also described differences in healthy eating policies and practices between private for-profit and non-profit service types. These descriptions were inconsistent with some describing for profit/private centres were more restrictive with food budgets and focused on profit maximisation whilst other constructions were more positive, describing more resources and support for healthy eating. Inconsistencies were described in how food was served, how they prioritised healthy eating and how staff were treated. Participants expressed frustrations at the inconsistencies and commented on the need for further support.

> I've been in many centres and every centre is different [...] So in my opinion, if we have something standard by the government would be good. (Participant 35, cook)

## 4 | Discussion

This study highlighted the importance of addressing contextual factors to support the implementation of healthy eating policies and practices in ECEC services located in NSW, one of only three Australian jurisdictions with government-funded state-wide healthy eating intervention. We used the CFIR to guide data collection and identification of *Inner setting* organisational factors and *Outer setting* factors encompassing the broader sociocultural, economic, environmental and political conditions. These findings build on previous qualitative research conducted in NSW by offering a more comprehensive understanding of the implementation context and *Outer setting* factors that may have previously been overlooked. Our study revealed that there was commitment from ECEC staff, support from directors, and healthy eating support provided by local health services. However, current ECEC sector conditions were not conducive to the successful implementation of healthy eating policies and practices. Implementation success was limited by inadequate work infrastructure to support collaboration between management, cooks, educators and families, lacking partnerships with external organisations, insufficient opportunities for nutrition training and education, and tension between regulatory requirements and educators and cooks.

Cooks were confident in their own capability to implement nutrition guidelines and educators were motivated to role model and implement healthy eating practices. This is consistent with previous literature highlighting that personal beliefs and experience influenced educator attitudes and confidence and guided their approach to feeding within their professional role [35]. Similarly, a study conducted in South Australia exploring factors influencing food service provision found that cooks were confident in their ability to manage challenges such as budget [36]. Findings from this study suggest cooks and educators are constrained by other educators, cooks and parents who do not share the same values and beliefs. Research shows that educators were more fulfilled when there were shared values and vision which allowed for great job control and low levels of emotional exhaustion [37]. Perceived inconsistencies in parent engagement or systems-level support can undermine educators' perception of their ability to implement healthy eating practices [38]. Whilst previous literature has primarily focused on educators, our findings suggest that similar challenges are also experienced by cooks. Furthermore, parent support and partnership were identified as important enablers but participants expressed frustration at inconsistencies between home and ECEC settings. These findings suggest that implementation support is needed to engage educators, cooks, providers, and families and strengthen collaborative efforts to implement healthy eating policy and practice. Staff communication, collaboration and well-established internal social networks have been identified as a facilitator to healthy food provision [15]. Further research to explore how to improve work infrastructure and organisational practices with centre management is recommended.

This study identified insufficient workforce nutrition education and training, and participants mostly relied on their own research. In comparison to previous studies which have identified

insufficient menu planning tools and difficulty finding easy to use resources [15, 16], cooks in this study were aware of the available menu planning tools and resources. This may be attributed to government-funded state-wide support available in NSW which provides tools and support to implement jurisdictional nutrition guidelines. However, the educators were less knowledgeable of nutrition education resources, suggesting further support to engage educators is needed. Our findings emphasised the need to improve on-the-job training and ongoing access to free training to overcome challenges to implement the guidelines such as accommodating food allergies and family preferences. Consistent with findings from South Australia which previously had a training programme which ended in 2013, there is currently a lack of ongoing training for cooks and chefs within the industry, limiting capacity to respond to complexities within their roles [18]. Providing ongoing training such as through an e-learning course can provide continual opportunities for professional development on a large scale in the ECEC setting [39]. Further research to investigate training and support strategies for ECEC staff to identify the most effective approaches for promoting healthy eating in early childhood settings is recommended.

We identified a tension between expectations of service providers, educators, cooks and regulatory requirements. Furthermore, inconsistencies in the implementation of healthy eating policies and practices between centres related to feeding practices were identified as a barrier to intervention success. Varying interpretations of the NQS may influence the implementation of healthy eating policies and practice [40]. Whilst the NQS emphasises the importance of promoting healthy eating, it lacks guidance on effective implementation. Additionally, the current assessment and rating process does not require observation of food provision, mealtime practices or related learning experiences. As a result, there may be discrepancies between policy and practice. For example, a previous study observing meals provided to children in ECEC services in highly disadvantaged communities found that these meals were not meeting the recommended serves of meat, vegetables, fruit, dairy and grains outlined by the Australian Dietary Guidelines [41]. Strengthening the NQS and guidelines to operationalise the standards may improve awareness and understanding of educators' and cooks' roles around healthy eating and support the implementation of nutrition guidelines [17, 20]. Additionally, strengthening the assessment and rating process is recommended to ensure that food provision and mealtime environments are in line with centre menus and policies. A more collaborative approach with regulatory authorities is needed to mentor ECEC staff through the compliance model, helping to align expectations and reduce tension [38].

However, growing job demands without adequate support and pay have been associated with high levels of burnout and stress, decreased wellbeing and increased staff turnover in the ECEC setting [28]. Participants expressed feeling undervalued, highlighting complex role-related challenges and a lack of time, partnerships and support networks to address these challenges, particularly amongst cooks. In addition to factors relating to the organisational and regulatory environment reported in previous studies, this study identified partnerships and connections as important enablers to implementing healthy eating policy and practice. Multisectoral partnerships are a crucial outer factor to ensure support for implementation and improve healthy eating in the ECEC setting [42]. Participants in this study highlighted the difference in systems-level support between the aged care sector and the ECEC sector. The aged care sector currently benefits from a government-funded workforce education and training programme which includes access to a trainer-mentor programme and professional community [43]. In the ECEC setting, a professional network for centre cooks to share experience, knowledge and support could enhance the implementation of healthy eating policies and practices.

Only participants from centres in advantaged areas consented to participate and most participants are currently employed at not-for-profit centres. As such, the sample may limit transferability of findings to all long day care services. Services located in advantaged areas are less likely to experience challenges compared to disadvantaged communities such as financial constraints and food insecurity [41, 44]. Additionally, the sample was determined by those who were interested and voluntarily elected to participate in the study, which may have resulted in a sample that over-represents educators and cooks who were personally motivated and confident to deliver healthy eating practices. Most participants were qualified, having completed TAFE or university, and experienced with a median of 9 years of experience in the ECEC sector (Table 1). Given widely reported challenges with staff shortages, burnout and stress, the included sample may not be representative of those who did not have time or capacity to participate. Whilst the sample may limit generalisability, it offers informed and meaningful insights from experienced participants who were more engaged in healthy eating, thus offering insights that may not be apparent to those less involved. Furthermore, they represent important experiences from the many children and families they collectively and cumulatively engage. Further research is warranted to explore the contextual factors of educators and cooks located in disadvantaged areas and other service types including family day care and lunch box services, to inform healthy eating policy and practice that reflects the diverse contexts and experiences within the ECEC setting.

## 5 | Conclusion

The ECEC setting can provide a critical opportunity to reach children and families to promote healthy eating behaviours at an early age. Whilst NSW is one of only three jurisdictions in Australia with government-funded state-wide support, findings from this study indicate that educators and cooks still experience significant gaps in systems-level support. Sector-wide challenges such as increasing job demands and insufficient paid time to complete tasks were identified as key challenges that require urgent attention. Supporting educators and cooks through provision of opportunities for professional development, partnerships and connections across the industry is recommended. There needs to be further guidance on how to achieve standards outlined in the NQS to promote healthy eating to ensure consistent implementation of healthy eating policies and practices across the ECEC sector. These recommendations support a more systematic approach and can strengthen collaboration amongst

educators, cooks, parents and providers across the ECEC sector to enhance implementation of healthy eating policies and practices.

### Author Contributions

J.C., A.H.-P., P.P., D.R. and M.A.-F. conceptualised and designed the research study. J.C. conducted the interviews. J.C. and M.A.-F. analysed the data. J.C. prepared the initial draft. A.H.-P., P.P., D.R. and M.A.-F. reviewed and edited the paper.


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### Ethics Statement

This study was approved by the Sydney Local Health District Human Research Ethics Committee (Project Number X23-0379).

### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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## Appendix A

### Demographic Characteristics Survey Questions

| Survey questions | Response categories |
|---|---|
| Service characteristics | |
| Which of the following best describes your service provider? | For-profit |
| | Non-profit |
| | Community based |
| What meals does your service provide? Select all that apply: | Breakfast |
| | Morning tea |
| | Lunch |
| | Afternoon tea |
| | Late snack |
| | Dinner |
| How is food prepared at your service? | All meals are cooked on site |
| | All meals are outsourced |
| | There is a mix of meals cooked on site outsourced |
| How many children are enrolled at your service? | |
| Participant characteristics | |
| How do you describe your gender? | Male |
| | Female |
| | Prefer not to say |
| | Other |
| Which age group includes your age? | 18–29 years |
| | 30–39 years |
| | 40–49 years |
| | 50–59 years |
| | 60–69 years |
| | 70 years and over |
| In which country were you born? The countries listed were the most reported countries of birth in the 2021 Census. For all other countries of birth, please select the 'Other (please specify)' | Australia |
| | England |
| | New Zealand |
| | India |
| | Philippines |
| | option. Vietnam |
| | Italy |
| | Other, please specify |
| What is your ancestry? | English |
| | Irish |
| | Scottish |
| | Chinese |
| | Italian |
| | Australian |
| | Other ancestry, please specify |
| Do you use a language other than English at home? If more than one language other than English, select the one that is used most often. | No, English only |
| | Yes, Mandarin |
| | Yes, Arabic |
| | Yes, Cantonese |
| | Yes, Vietnamese |
| | Yes, Italian |
| | Yes, Greek |
| | Yes, other, please specify |
| What is your highest level of education? | Degree (bachelor, masters, doctorate) |
| | Graduate or advanced diploma |
| | Certificate I–IV |
| | Secondary education – years 10 and above |
| | Secondary education – years 9 and below |
| | Other, please specify |

## Appendix B

### Semi-Structured Interview Guide

**Note:** Prompts have been provided to help guide the interview and probe for more information if needed; however, **not all prompts will be asked.**

**Introduction**

- Thank you for participating in this interview. Introduce the interviewer and their role.
- In this interview, I want to ask about your expert experience and knowledge as a director/educator/cook and understand what has helped or hindered your service to deliver and continue to provide healthy eating activities.
- The interview will take about 30–40 min and will be audio recorded. Your answers will then be written as notes and sent back to you for comment and/or correction. The recordings and written notes will be stored securely and used only for the purpose of this study.

- All information you provide will be confidential and you will not be identified by name in any report.
- Participation in this interview is voluntary. You are not required to answer any questions that make you feel uncomfortable. You are free to withdraw from participation at any stage.
- By participating, you are telling us you understand what you have read in the participant information sheet and consent to take part in an interview and for this information to be used in this study.
- Please ask questions about anything you do not understand or want to know more about. Do you have any questions before we begin?

To begin with, could you please briefly tell me about your role in the service?

- What is your role around food (e.g., preparation, food service, menu planning)?
- How many years of experience do you have working in early childhood education and care?

Thank you. I will now move on to some questions that will help us understand what helps or hinders your service to provide healthy eating.

| CFIR domain | Objectives | Interview questions: educators | Interview questions: cooks |
|---|---|---|---|
| Context | To identify interventions currently being implemented | 1. Can you tell me about any rules/guidelines, activities or projects at your service that support children and families with healthy eating?<br>• What do you like about it?<br>• What do you dislike? | 1. Can you tell me about any rules/guidelines, activities or projects at your service that support you to provide healthy food?<br>a. What do you like about it?<br>b. What do you dislike? |
| Innovation | To identify the components of the innovation that enable and/or inhibit implementation and sustainment of nutrition interventions. | 2. What features would you need to continue, improve or discontinue the rules, activities or projects?<br>Prompts:<br>– What would you change and why? What would you keep and why? | 2. What features would you need to continue, improve or discontinue the rules, activities or projects?<br>Prompts:<br>– What would you change and why? What would you keep and why? |
| Inner setting | To identify the inner setting organisational barriers and enablers to implementation and sustainment of nutrition interventions. | 3. How does supporting children and families with healthy eating fit within your priorities as an educator?<br>Prompts:<br>– What are the values/beliefs around healthy eating?<br>4. Tell me about the resources available in your service to support children and families with healthy eating.<br>Prompts:<br>– How does the space/layout and equipment at your service influence how you support healthy eating?<br>– How does management or leadership support influence how you support healthy eating?<br>– What are the incentives or rewards for supporting healthy eating at your service?<br>– Tell me about any guidance or training you get for supporting healthy eating.<br>5. What resources do you need to continue supporting healthy eating? | 3. How does providing healthy food fit within your priorities as a cook?<br>Prompts:<br>– What are the values/beliefs around healthy foods?<br>4. Tell me about the resources available in your service to provide healthy food.<br>Prompts:<br>– How does space and equipment for cooking change how you provide healthy food?<br>– How does cost/budget change how you provide healthy food?<br>– How does management or leadership support change how you provide healthy foods?<br>– What are the incentives or rewards for providing healthy food at your service?<br>– Tell me about any guidance or training you get for providing healthy food.<br>5. What resources do you need to continue providing healthy eating? |

| CFIR domain | Objectives | Interview questions: educators | Interview questions: cooks |
|---|---|---|---|
| Outer setting | To identify the outer setting barriers and enablers to implementation and sustainment of nutrition interventions. | 6. Tell me about the things outside the control of your service that effect how you support children and families with healthy eating?<br>Prompts:<br>– How has the way you support healthy eating been affected by big events (e.g., COVID-19)?<br>– How has the way you support healthy eating been changed by community values/beliefs?<br>– How has the way you support healthy eating been changed by community/external resources (e.g., healthy eating apps/programs)?<br>– How has the way you support healthy eating been changed by external entities (e.g., professional networks, community partners)?<br>7. What external support do you have/would you need to continue to support children and families? | 6. Tell me about the things outside the control of your service that effect how you provide healthy food?<br>Prompts:<br>– How has the way you provide healthy food been changed by big events (e.g., COVID-19)?<br>– How has the way you provide healthy food been changed by healthy eating policies and guidelines?<br>– How has the way you provide healthy food been changed by community values/beliefs?<br>– How has the way you provide healthy food been changed by community/external resources (e.g., menu planning apps/programs)<br>– How do you order and shop for healthy foods?<br>7. What external support do you have/would you need to continue providing healthy food? |

**Close of the interview:**

Is there anything else you would like to add?

If you experience any discomfort or distress from the interview, please refer to the Participant Information Sheet for support services that you can contact. Thank you for participating in this interview today, we really value your insight and appreciate your time. I will email you a summary of the results of this study once they are ready if you have requested this in your consent form.