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Nutrition and food systems education for secondary school students in Australia and Iran

Sanaz Sadegholvad
University of Wollongong

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Nutrition and food systems education for secondary school students in Australia and Iran

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This thesis is presented

as part of the requirement for the conferral of the degree:

Doctor of Philosophy

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School of Health and Society

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Dedication

To Mostafa, Nila, Fahimeh, Hadi, Sasha and Ali

Love you all very much

Sanaz

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Abstract

Introduction: The need to improve consumers' knowledge of nutrition has been raised in literature. However, few studies have encompassed the broad range of important nutrition and food systems (N&FS) issues that affect population health, environmental sustainability and animal welfare. Also not well explored is the most efficient and effective N&FS education strategies.

Objectives: This research project aimed to explore the perspectives of prominent Australian and Iranian food professionals regarding: 1) essential N&FS knowledge issues for secondary school students, 2) gaps in Australian and Iranian school-leavers' knowledge of N&FS and 3) effective strategies to improve school-leavers' knowledge of N&FS.

Methods: Semi-structured face-to-face or telephone-based interviews were conducted with 21 food professionals in five states or territories of Australia (New South Wales, Victoria, Queensland, Western Australia and the Australian Capital Territory). Similar interviews were conducted with 28 professionals in Iran from four major provinces (Fars, Tehran, Isfahan and Gilan). Australia, as a developed country, and Iran, a developing country, were selected for comparison.

Participants in Australia were: three public health nutritionists, four dietitians, four nutritionists, one public health expert, two food scientists, four home economists, two veterinary physicians (experts in animal welfare and animal-sourced food production systems) and one environmental scientist. Participants in Iran included: five public health nutritionists, five dietitians, five nutritionists, four food scientists, four school teachers, two veterinary physicians, two environmental scientists and one agriculture scientist. Interviews conducted in Australia were transcribed verbatim for analysis. Interviews conducted in Iran were transcribed verbatim (in Farsi) and translated from Farsi to English. The transcribed data were entered into NVivo version 10 and were analysed thematically.

Results: Gaps in Australian and Iranian school-leavers' knowledge of N&FS were identified, and factors that affected their knowledge were determined. Australian

professionals raised the need to integrate N&FS lessons into current core subjects in schools, increase food-related skill development activities in schools, increase cross-disciplinary actions regarding designing and implementing N&FS education programs for schools, and increase positive activities of mass media in broadcasting more food-related educational materials. Similar education interventions were raised by Iranian professionals. In addition, Australian professionals highlighted the important role of parents in the home setting as proper role models and informed food educators, and Iranian professionals highlighted the important role of national government to increase its financial support for school-based N&FS education programs.

Findings related to Australia and Iran were compared to identify the similarities and differences in food professionals' views. Professionals in both countries reported a wide range of similar views, such as the need to make specific improvements in current N&FS components of secondary school curriculum, to integrate N&FS lessons into current core subjects, to increase the development of food-related skills in schools, to increase cross-disciplinary actions regarding designing and implementing N&FS education programs for schools, and to increase the number of food-related educational programs broadcast in the mass media. There were some differences in the recommendations by Australian and Iranian food-related professionals; these mainly reflected the cultural, economic and political circumstances of these countries. Comparison of the findings from Australia and Iran resulted in the development of a potential universal guide for N&FS education for adolescents.

Discussion and conclusion: This study developed five guides for N&FS education programs. Two guides include essential N&FS knowledge issues for Australian and Iranian school-leavers. Two guides (one each for Australia and Iran) outline the best strategies to improve school-leavers' knowledge of N&FS. Also, one potentially universal guide was developed, which uses the Ottawa Charter for Health Promotion to formulate appropriate N&FS education for adolescents. Findings related to Australian and Iranian studies provide important guidance for the development of N&FS curricula in secondary schools,

and enrich and support the provision of N&FS education initiatives for Australian and Iranian adolescents. The guides will also support international educators, curriculum developers and policymakers in improving N&FS education programs for adolescents.

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List of peer-reviewed publications developing this thesis

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Sadegholvad S, Yeatman H, Parrish AM, et al. (Under review) Gaps in adolescents' knowledge of nutrition and food systems: a comparison of a developed country and a developing country. *Health Promotion Journal of Australia*.

Sadegholvad S, Yeatman H, Parrish AM, et al. (2017) Views from prominent food-related professionals in Australia. *Nutrients* 9(11): 1–14.

Sadegholvad S, Yeatman H, Parrish AM, et al. (2017) Experts' views regarding Australian school-leavers' knowledge of nutrition and food systems (N&FS). *Australia and New Zealand Journal of Public Health* 41(5): 502–507.

Sadegholvad S, Yeatman H, Parrish, AM, et al. (2017) Best strategies to improve Australian school-leavers knowledge of nutrition and food systems. Views of prominent food-related experts in Australia. *Nutrients* 9(844): 1–12.

Sadegholvad S, Yeatman H, Omidvar N, et al. (2017). Essential nutrition and food systems components for school curricula: views from experts in Iran. *Iranian Journal of Public Health* 46(7): 938–947.

Sadegholvad S, Yeatman H, Omidvar N, et al. (2017) Gaps in Iranian school-leavers' current knowledge of nutrition and food systems. *Iranian Journal of Public Health* 46(11): 1589–1590.

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Certification

DECLARATION

I, Sanaz Sadegholvad, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Health and Society, Faculty of Social Sciences, University of Wollongong, Australia, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Sanaz Sadegholvad

July 2018

List of abbreviations

ABS	Australian Bureau of Statistics
BMI	body mass index
FAO	Food and Agriculture Organization
N&FS	nutrition and food systems
NHPA	National Health Priority Area
NNS.....	new nutrition science
PHAA.....	Public Health Association of Australia
WHO.....	World Health Organization

Chapter 1: Introduction

1.1. The importance of nutrition and food systems (N&FS) knowledge

It is well recognised that healthy eating is associated with a decrease in diet-related health risks such as diabetes, cardiovascular disease and cancer (O'Toole et al., 2007). In addition, healthy dietary patterns may increase an individual's life expectancy and quality of life (O'Toole et al., 2007). Globally, dietary trends toward over-nutrition in high-income countries have been identified (Huffman et al., 2010), which have been reflected in increased consumption of refined carbohydrates, added sugars and fats in middle- and low-income countries (Popkin et al., 2012).

Healthy dietary behaviours is the primary focus of traditional nutrition science; however, the importance of food systems issues is also highlighted in the context of food-related education programs (Harmon and Maretzki, 2006b). "Food systems" is a term used to describe:

... the process of food production, distribution, preparation, and preservation; food use and consumption; the recycling and disposal of food wastes; and the systems that support this process including marketing, transportation, storage, and government services (Harmon and Maretzki, 2006b: 91).

The food system is increasingly complex, and we are seeing people's separation from food production, links between dietary behaviours and poor health outcomes, and the impacts of food production systems on environment and natural resources. This combination has resulted in an increasing focus on the need to review people's knowledge of food systems and dietary issues (Yeatman, 2016).

Various nutrition education programs across the world have been developed and implemented (Spronk et al., 2014); however, rates of diet-related illnesses continue to increase (Parrish et al., 2016). Traditionally, nutrition education has focused on promoting healthy dietary behaviours to achieve better health

outcomes (Contento et al., 1995). More recently, the need to improve knowledge of food systems has also been raised in literature (Harmon and Maretzki, 2006b). Increasing recognition of the importance of food systems knowledge could be considered to reflect the increased complexities of food systems and the impacts that human consumption patterns have on not only human health but also the sustainability of our food systems. For example, there is increased recognition of the contributions that increased consumption of highly processed, energy-dense foods and animal-based products (especially lamb and beef) make to climate change and environmental degradation (Friel et al., 2014). Food systems investigators have recommended improving consumers' knowledge of food systems to promote food choices that are more supportive of environmental sustainability and natural resource management (Harmon and Maretzki, 2006b).

Globally, the majority of studies in this area have documented the essential components of nutrition knowledge that support food behaviours for human health. Some of the components of nutrition knowledge that have been explored include knowledge of food labels to enable consumers to use label information to make healthier choices (EunSeok et al., 2014; Liu et al., 2015), knowledge of food safety to improve safe food practices (Farahat et al., 2015; Green and Knechtges, 2015), development of food preparation and cooking skills to support healthy dietary intake (Engler-Stringer, 2010; Reicks et al., 2014), and gardening activities to increase fruit and vegetable intake (Yoder et al., 2014; Brendamour, 2015). The aim of these studies was to encourage food-related activities that are supportive of human health and wellbeing. However, identifying the essential components of food systems knowledge has not been well investigated.

Several assessment tools have been developed to measure people's knowledge of a range of important nutrition issues (Parmenter and Wardle, 1999; Wardle et al., 2000; Bukenya et al., 2017). A well-recognised, validated instrument developed by Parmenter and Wardle (1999) assesses knowledge of dietary recommendations, food sources of nutrients, daily food selections, and nutrition-related health problems. However, globally, there are few instruments that assess individuals' knowledge of food systems and relevant issues (e.g. knowledge of

foods from farm to fork, in conjunction with environmental sustainability and animal welfare). Therefore, it is not surprising that consumers' knowledge of food system issues have not been well explored or reported. An exception is a tool developed by investigators in the US (Harmon and Maretzki, 2006b) that aimed to assess food systems knowledge beyond health-related aspects of nutrition and food consumption. This instrument explored knowledge in relation to food sources, food system sectors, local foods, sustainability and hunger (Harmon and Maretzki, 2006b).

Although a paucity of studies investigate the broad range of food systems knowledge issues, there are some studies that have investigated particular components of food systems knowledge. For example, Worsley and colleagues (2015a) explored adults' knowledge of agriculture. Consumers' knowledge of farm animal welfare and food production systems has also been explored (Taylor and Signal, 2009; Vecchio and Annunziata, 2012). At present, a study by Harmon and Maretzki (2006b) is the only reported assessment of participants' knowledge of a broad range of food systems issues. These investigators highlighted the need to promote informed food choices among consumers in order to support food systems sustainability, natural resources, environmental sustainability and other food-related ethical issues.

In brief, few studies have encompassed the broad range of important issues that relate to N&FS knowledge, such as population health, environmental sustainability and animal welfare. In addition, few studies have considered consumers' knowledge of nutrition in conjunction with their knowledge of food systems. As a consequence of such gaps in the literature, there is a lack of guidance for food researchers, food educators, education curriculum developers and policymakers in the assessment and development of appropriate N&FS education programs.

This research project aimed to develop guidance for N&FS education policymakers and educators, by identifying essential nutrition and food systems knowledge components for school-leavers, exploring perceptions of school-leavers' level of knowledge of important N&FS issues, and identifying potential

strategies to promote and support N&FS education. To enable comparison, the research comprised two national perspectives: a developed country (Australia) and a developing country (Iran).

1.2. Overview of nutrition and food systems issues in the context of Australia

In Australia, high consumption of energy-dense and low-nutrient foods, and low consumption of fruits and vegetables have created serious public health concerns (Daraganova and Thornton, 2013). The Australian Institute of Health and Welfare (2016) has identified obesity, cardiovascular health, and cancer control as national health priorities. These health conditions are significantly affected by individuals' dietary patterns (World Health Organization [WHO], 2003). For example, over-consumption of foods that are high in fat and sugar, and low in essential micronutrients can lead to obesity and diabetes (Daraganova and Thornton, 2013). High consumption of saturated fats, trans fats and salt, and low consumption of fruits and vegetables can increase the risks of cardiovascular disease (WHO, 2003). In addition, some types of cancers are linked to low consumption of fruits and vegetables (WHO, 2003).

Researchers have investigated Australians' knowledge of various health-related aspects of food and nutrition, including on food safety to prevent foodborne illnesses (Worsley et al., 2013), food labels to support healthier food choices (Mhurchu and Gorton, 2007), foods and nutrients in relation to the risk of metabolic diseases (Worsley et al., 2014), nutrition requirements during pregnancy (Bookari et al., 2016), and nutrition to support healthier dietary behaviours (Hendrie et al., 2008a). The researchers all highlighted the need for further nutrition-related education for Australians.

In Australia, there has been a rapid increase in the number of studies investigating the identification and implementation of essential food skill interventions, such as shopping, food preparation, cooking (Fordyce-Voorham, 2011a) and gardening (Somerset and Markwell, 2009). More recently, some Australian studies focused on incorporating the principles of environmental

sustainability into dietary guidance and food selection (Friel et al., 2014; Public Health Association of Australia [PHAA], 2015a). The Public Health Association of Australia (PHAA) in its food policy document highlighted the importance of informing consumers about ecological sustainability and the need to integrate ecologically sustainable principles into the Australian Dietary Guidelines (PHAA, 2015a). The report highlighted that ecologically sustainable diets were not only supportive and respectful of the climate, ecosystems and natural resources but also supportive of health considerations, affordability, cultural variation and nutritional requirements (PHAA, 2015a). Unfortunately, current diets in Australia do not reflect environmental sustainability and are not consistent with the recommendations of the Australian Dietary Guidelines (PHAA, 2015a).

Very few studies in Australia have focused on Australian consumers' knowledge of particular food systems issues. One of the few existing studies, conducted by Worsley and colleagues (2015a), explored Australian adults' knowledge of agriculture. The other study, by Taylor and Signal (2009), explored Australian consumers' self-reported knowledge of farm animal welfare and their willingness to pay for food products that support animal welfare. However, no studies have been identified that explored Australians' knowledge of a broad range of components of food systems.

There also is a global scarcity of literature related to the assessment of consumers' knowledge of a broad range of food systems issues. One exception is a US study that explored adolescents' knowledge of food origins, sustainability, agriculture, food systems sectors, local foods and hunger (Harmon and Maretzki, 2006b).

The limited research encompassing the broad range of N&FS issues has resulted in the lack of an appropriate framework for assessing N&FS knowledge. To initiate the development of such a framework, this study sought the perspectives of food and nutrition-related professionals.

This research aimed to explore Australian professionals' views regarding important N&FS topics for school-based education purposes, and the status of

Australian school-leavers' knowledge of a broad range of N&FS issues. It was anticipated that the results of this research would form the basis of future studies that would undertake more in-depth exploration of young adults' knowledge of a range of food systems issues, in both Australia and other countries.

1.3 Overview of nutrition and food systems issues in the context of Iran

In 2002, chronic diseases were identified by the World Health Organization (WHO) as the cause of more than 70% of all deaths in Iran (WHO, 2002). Transition toward poor dietary practices and the prevalence of sedentary behaviours were reported as two key factors resulting in the increased prevalence of chronic diseases in Iran (Ghassemi et al., 2002).

Many Iranian studies confirmed the important role of a healthy diet in the prevention and management of chronic conditions such as cardiovascular disease (Tavassoli et al., 2015a), diabetes (Sharifirad et al., 2009), obesity (Malekzadeh et al., 2005) and cancer (Salehi et al., 2010). These studies all raised the need to provide nutrition education programs to support the health and wellbeing of Iranians.

No Iranian literature explored Iranians' knowledge of a broad range of N&FS issues. Like in Australia and other countries, Iranian investigators addressed particular nutrition knowledge issues, such as food groups (Ahadi et al., 2014), food labels (Ahmadi et al., 2013) and food safety (Askarian et al., 2004; Tabrizi et al., 2017), with the aim of achieving better health outcomes (Sharifirad et al., 2009; Tavassoli et al., 2015b; Tabrizi et al., 2017). However, compared with research from other countries, there is a lack of Iranian research on food skills that have been identified as effective in supporting healthier dietary practices, such as shopping (Fordyce-Voorham, 2011a), cooking (Reicks et al., 2014) and gardening (Somerset and Markwell, 2009).

In addition, as reported for Australia, food systems education is absent in Iranian food and nutrition literature. This research project aimed to address these gaps in Iranian studies of food knowledge.

1.4 Schools: a unique setting for nutrition and food systems education programs

The school setting is an important part of young people's lives, and it is where they spend a large proportion of their day. It is appropriate to consider how schools create curricula, physical environments and social atmospheres that promote the health of students, staff, families and communities (Hsu and Turgeon, 2013). In relation to food knowledge, school-based nutrition education programs have been found to improve students' knowledge, behaviours and attitudes (Olson et al., 1993). Nutrition education investigators have reported that "nutrition education in elementary schools can provide children with the information and skills to develop healthy food choices and dietary behaviors" (Perera et al., 2015: 41). Researchers also suggested the need for adolescents to achieve food literacy to encourage them to develop healthier dietary behaviours (Ronto et al., 2016b).

The school setting has thus been recognised as having a role in offering food education programs. However, while school-based nutrition education has been positioned broadly, including the need to provide nutrition information and to promote students' food-related skills and behaviours (Pérez-Rodrigo and Aranceta, 2003), studies have reported that the potential for schools to deliver such food and nutrition education programs has not yet been met (Perez-Rodrigo and Aranceta, 2003; Kazemian et al., 2014; Carraway-Stage et al., 2015). Several studies in different countries have raised the need to improve and strengthen school-based food education programs (Pérez-Rodrigo and Aranceta, 2003; Kazemian et al., 2014; Carraway-Stage et al., 2015).

One focus of this research was to elicit ideas on ways to improve N&FS education through the formal education systems in Australia and Iran.

1.5 Recommended methods to educate students about nutrition and food systems in schools

Within the schools systems, different food education strategies have been considered. The broad range of teaching methods in the school setting

recommended in the literature has included “classroom discussions, work-sheets and keeping food records; to shopping exercises, tasting, creating, or drama” (Pérez-Rodrigo and Aranceta, 2001:132). A WHO guide on school health recommended the combination of various methods to improve students’ knowledge, skills and attitudes in relation to health issues (including nutrition) (WHO, 1998).

Particular teaching techniques recommended by investigators have included integrating nutrition lessons with other core subjects such as science and mathematics in school curricula (Pérez-Rodrigo and Aranceta, 2003; Carraway-Stage et al., 2015); school-based food skill activities, particularly food preparation, cooking (Ensaff et al., 2015; Ritchie et al., 2015) and school gardening (McAleese and Rankin, 2007; Morgan et al., 2010); and game-based dietary innovations (Jui-Mei et al., 2011; Sharma et al., 2015). These teaching strategies are yet to be widely explored or evaluated.

Globally, a limited number of studies have focused on the effectiveness of teaching strategies for school-based N&FS education programs. A recent systematic review and meta-analysis identified experiential learning strategies and cross-curricular techniques as the best interventions to improve children’s dietary behaviours (Dudley et al., 2015). The focus of that review was on the improvement of healthy dietary behaviours of schoolchildren, but it did not consider teaching/learning approaches for food systems knowledge issues (e.g. agriculture and environmental sustainability).

1.6 Review of major gaps in literature that formed the aims of this research project

As well as identifying how food and nutrition education can effectively be offered, the range of important N&FS knowledge issues for education purposes needs to be established. There is a scarcity of peer-reviewed guides reflecting important N&FS issues for Iranian students. In studies related to Australia, some guides regarding components of food literacy have recently been developed (e.g. Vidgen and Gallegos, 2014; Ronto et al., 2016b). However, these food literacy guides do

not consider some aspects of food systems literacy, such as food production from farm to fork, and food ethics more broadly.

The range of N&FS knowledge areas to include in school curricula could be informed by studies that have explored N&FS issues. Australian studies have focused on knowledge associated with population health (Mhurchu and Gorton, 2007; Worsley et al., 2013; Bookari et al., 2016). However, Australians' knowledge of food systems issues (e.g. knowledge of food production from farm to fork) has not been well explored. Also lacking is literature exploring Australians' knowledge of a wide range of N&FS issues in a single investigation.

Identifying the strengths and weaknesses of knowledge of a wide range of N&FS issues can guide food educators and relevant policymakers to build more appropriate food education programs for different population groups. Thus, this research aimed to address this gap in the literature by exploring the perspectives of Australian and Iranian food professionals regarding the N&FS knowledge of Australian and Iranian school-leavers.

1.6.1 Specific aims

This research aimed to:

- 1) identify important N&FS issues that Australian and Iranian school-leavers need to know, from the perspectives of prominent food professionals
- 2) investigate food professionals' views of Australian and Iranian school-leavers' current knowledge of N&FS
- 3) identify the best strategies to improve Australian and Iranian school-leavers' knowledge of N&FS, from the perspectives of Australian and Iranian food professionals
- 4) compare and contrast the views of Australian and Iranian food experts regarding nutrition and food system knowledge and education.

1.7 Frameworks that guided this research

1.7.1 New nutrition science

Whereas nutrition science has provided valuable insights into increasingly specific mechanistic relationships within the human and animal body, it has tended to pay less attention to social and environmental contexts (Lawrence and Worsley, 2007: 10).

To address this gap, new nutrition science (NNS) was developed to consider broader aspects of nutrition – such as biological, environmental, social and cultural aspects – which affect people’s food choices, and food systems (Lawrence and Worsley, 2007). This approach was proposed to overcome the limitations of the traditional biological focus that did not sufficiently account for contemporary nutrition-related issues (Leitzmann and Cannon, 2005). However, NNS has not been well integrated into nutrition education programs in different education settings, such as schools.

This study aimed to consider the multidimensional perspectives of NNS by integrating food systems with traditional, health-directed nutrition.

1.7.2 Yang’s knowledge theory

Knowledge, the focus of this investigation, is a complex concept (Yang, 2003). This research was guided by the multifaceted approach of the epistemology of knowledge and learning developed by Yang (2003).

Yang’s (2003) approach is based on three facets of knowledge: explicit, implicit and emancipatory. The explicit facet represents theoretical knowledge – for example, knowledge that we attain from textbooks. The implicit facet reflects practice (experimental knowledge), which is developed through experiences. The emancipatory facet of knowledge is mainly transferred by values and ethics (Yang, 2003).

The multifaceted nature of Yang’s theory is consistent with the multidimensional structure of NNS. Indeed, three facets of knowledge identified by Yang covered

scientific aspects of food and nutrition (explicit); food skills (implicit); and cultural and value-based factors associated with food issues (emancipatory). Employing this knowledge framework in the current research revealed the extent to which recruited food professionals from Australia and Iran reflected these facets of knowledge. Adoption of such philosophical knowledge-based frameworks is not common in the food and nutrition knowledge/education domain.

1.8. Thesis outline

This thesis includes 12 chapters, eight of which are peer-reviewed papers, including six published papers and two at the peer review stage. Slight changes have been made to the formatting of published papers. These changes relate to the numbering of tables and figures, and referencing styles, to create coherence in the thesis. Author date Sage Harvard referencing style is adopted for this thesis.

In addition to the eight peer-reviewed chapters, the remaining four chapters comprise this introduction; Chapter 2, Literature review; Chapter 3, Study methodology; and Chapter 12, Discussion of key findings, which forms the conclusion. The thesis outline is presented in Table 1.1.

Table 1.1 Outline of thesis chapters

Chapter	Peer-reviewed chapters	Publication status and related citation
Chapter 1 Introduction	Nil	N/A
Chapter 2 Literature review	Nil	N/A
Chapter 3 Study methodology	Nil	N/A
Chapter 4 Australian study, part 1	Journal article	Published Sadegholvad S, Yeatman H, Parrish AM, et al. (2017) What should be taught in secondary schools' nutrition and food systems education? Views from prominent food-related professionals in Australia. <i>9</i> (11): 1–14.
Chapter 5 Australian study, part 2	Journal article	Published Sadegholvad S, Yeatman H, Parrish AM, et al. (2017) Experts views regarding Australian school-leavers knowledge of nutrition and food systems (N&FS). <i>Australia and New Zealand Journal of Public Health</i> 41(5): 502–507.
Chapter 6 Australian study, part 3	Journal article	Published Sadegholvad S, Yeatman H, Parrish AM, et al. (2017) Best strategies to improve Australian school-leavers knowledge of nutrition and food systems. Views of prominent food-related experts in Australia. <i>Nutrients</i> 9(884): 1–12.
Chapter 7 Iranian study, part 1	Journal article	Published Sadegholvad S, Yeatman H, Omidvar N, et al. (2017) Essential nutrition and food systems components for school curricula; views from experts in Iran. <i>Iranian Journal of Public Health</i> 46(7): 938–947.
Chapter 8 Iranian study, part 2	Letter to the editor	Published Sadegholvad S, Yeatman H, Omidvar N, et al. (2017) Gaps in Iranian school-leavers' current knowledge of nutrition and food systems. <i>Iranian Journal of Public Health</i> 46(11): 1589–1590.

Chapter	Peer-reviewed chapters	Publication status and related citation
Chapter 9 Iranian study, part 3	Journal article	Published Sadegholvad S, Yeatman H, Omidvar N, et al. (2016) Best strategies to improve school-leavers' knowledge of nutrition and food systems: Views from experts in Iran. <i>International Journal of Preventive Medicine</i> 7(119): 26–34.
Chapter 10 Comparison of Australian and Iranian studies, part 1	Journal article	Under review Sadegholvad S, Yeatman H, Parrish, AM, et al. (Under review) Rethinking a framework for N&FS education using the Ottawa Charter. <i>British Food Journal</i> .
Chapter 11 Comparison of Australian and Iranian studies, part 2	Commentary	Under review Sadegholvad S, Yeatman H, Parrish AM, Omidvar N, and Worsley A (Under review) Gaps in adolescents' knowledge of nutrition and food systems: a comparison of a developed country and a developing country. <i>Australia and New Zealand Journal of Public Health</i> .
Chapter 12 Discussion of overall findings and conclusion	Nil	N/A

1.8.1 An overview of chapters within this thesis

Chapter 1 provides background information regarding the importance of N&FS and appropriate methods for N&FS education programs. The chapter introduces the aims of the study and an presents an outline of the thesis.

Chapter 2 presents a review of literature on important N&FS knowledge issues for school-leavers; gaps in the N&FS knowledge of Australian and Iranian school-leavers; and best techniques for N&FS education.

Chapter 3 provides an overview of the methodology and methods used in the research. The reasons behind the selection of these procedures to fulfil the aims

of the current research are described. The settings, participants and process of data collection, data analysis and interpretation of findings are described.

Chapter 4 introduces the Australian study. This chapter focuses on identifying essential N&FS knowledge issues for Australian school-leavers from the perspectives of 21 prominent food professionals in Australia. The chapter has been published as a peer-reviewed journal article in *Nutrients* journal.

Chapter 5 describes the second part of the Australian study. The chapter presents an outline of the perspectives of 21 Australian food professionals regarding the status of Australian school-leavers' knowledge of N&FS. The chapter has been published as a peer-reviewed article in the *Australia and New Zealand Journal of Public Health*.

Chapter 6 explains the third part of the study related to Australia. This chapter presents the 21 Australian food professionals' recommended strategies to educate secondary school students regarding essential N&FS issues. This chapter has been published as a peer-reviewed article in *Nutrients* journal.

Chapter 7 reports the findings related to the first part of the Iranian study. This chapter focuses on the perspectives of 28 prominent food professionals in Iran regarding essential N&FS knowledge issues for Iranian school-leavers. This chapter has been published in the *Iranian Journal of Public Health*.

Chapter 8 relates the second part of the Iranian study. The chapter reports the perspectives of 26 Iranian food professionals regarding Iranian school-leavers' knowledge of N&FS. This chapter comprises a short research paper and a letter to the editor. Both papers were prepared for the *Iranian Journal of Public Health*, and the letter to the editor was published.

Chapter 9 describes the third part of the Iranian study and was published as a peer-reviewed journal article in the *International Journal of Preventive Medicine*. The chapter presents 28 Iranian food professionals' recommendations on the best methods to improve Iranian school-leavers' knowledge of N&FS.

Chapter 10 presents a comparison of the findings from chapters 4, 6, 7 and 9. The WHO's Ottawa Charter for Health Promotion is used as the framework for this comparison. The findings from the Australian and Iranian studies are presented as two case studies of a developed country and a developing country, respectively. Similarities and differences between Australian and Iranian studies in the context of the Ottawa Charter are used to develop a guide for N&FS education programs for adolescents. A manuscript presenting relevant findings is under review for publication in the *British Food Journal*.

Chapter 11 compares food professionals' perceptions of the gaps in N&FS knowledge of Australian and Iranian school-leavers (chapters 5 and 8). This chapter is written as a commentary and is under review for publication in the *Australia and New Zealand Journal of Public Health*.

Chapter 12 is the final chapter of this thesis. It briefly describes the key findings of this research, and provides some details on the significance and limitations of this research. This chapter also includes some recommendations and identifies potential future studies in the area of N&FS education.

Chapter 2: Literature review

Preface

This chapter presents the background literature relevant to this research. It is divided into four parts:

- Part 1 provides brief background information on nutrition knowledge, nutrition education and schools as an appropriate setting for nutrition education programs.
- Part 2 draws on literature about knowledge of various essential nutrition and food systems (N&FS) issues for school-leavers, and the status of their knowledge about these issues. Issues discussed include general nutrition knowledge, cooking skills, gardening practices, food safety knowledge, food systems knowledge and farm animal welfare. Studies based in Australia and Iran are also explored separately.
- Part 3 presents a review of literature about the best strategies to improve adolescents' knowledge of N&FS in secondary schools. Approaches include integrative curricula, incorporation of a wide range of teaching techniques, and school-based activities to develop skills .
- Part 4 of the literature review presents an overview of conceptual frameworks relevant to this research. Three conceptual frameworks are highlighted, including new nutrition science, Yang's theory of knowledge and the World Health Organization's (WHO's) Ottawa Charter for Health Promotion.

In the next chapter, the study methodology is presented.

2.1. Part 1: Overview

2.1.1. An overview of nutrition knowledge in the literature

Knowledge helps us explain important aspects of the world and gives predictability to events, thus meeting the human need for cognitive consistency or predictability (Worsley, 2002: 580).

“Knowledge” has been defined as accurate and explanative information that enables individuals to take informed actions (Sharma et al., 2008). Worsley (2002)

referred to two types of knowledge. The first, declarative knowledge, relates to “what is” (e.g. “the earth is round”); the second, procedural knowledge, relates to “how to do things” (e.g. “how to choose a low salt packet of soup”) (Worsley, 2002). Similarly, Dickson-Spillmann and Siegrist (2011) also reference two types of knowledge: “knowing what” and “knowing how”. These investigators stated that declarative knowledge implied knowledge of facts – for example, the calorie content of low-fat milk, or the nutritional content of fruits and vegetables (Dickson-Spillmann and Siegrist, 2011). They described procedural knowledge as the method of doing an action – for example, how to select a healthier snack among other snacks or how to create a healthy, balanced food menu. Thus, knowing how to adopt a healthy dietary behaviour requires the acquisition of procedural knowledge (Dickson-Spillmann and Siegrist, 2011).

In the health-related literature, nutrition knowledge has been understood to be a key component of understanding health, and it has been reported that limited knowledge of health can negatively affect people’s health status (Spronk et al., 2014). Worsley (2002) noted that, although nutrition knowledge was not sufficient to change dietary behaviours, it was still an essential precursor to behavioural change. Rustad and Smith (2013) also noted that some investigations identified nutrition knowledge as an “unreliable” factor in changing dietary behaviour; however, they considered nutrition knowledge was essential in “promoting favourable dietary and health changes” (p. 490).

2.1.2 An overview of nutrition education in literature

The close link between nutrition education and nutrition knowledge has been well recognised. Nutrition education programs aimed to improve individuals’ nutrition knowledge to support appropriate dietary behaviours among a specific population group (or groups) or in the whole community (Spronk et al., 2014). Settings for nutrition education include schools, health promotion and government organisations (Spronk et al., 2014).

Traditional nutrition education has mainly been designed with a focus on the improvement of the health status of various population groups in the communities (Harmon and Maretzki, 2006a). Nutrition education for better health outcomes has been extensively explored in older and more recent nutrition studies, in the context of food safety education in schools (Zhou et al., 2016), gardening programs, adolescents' body mass index (BMI) and nutrition (Utter et al., 2016), school-based nutrition education and its impacts on fruit and vegetable intake (Anderson et al., 2005), nutrition education for the prevention and treatment of chronic disease for older people (Son and Kim, 2001), nutrition education for obese children and their parents (Shin et al., 2004), and effects of nutrition education on dietary behaviour (Powers et al., 2005).

In addition to traditional nutrition education, food systems education has been recommended to promote informed food choices that aim to protect the environment and natural resources (Harmon and Maretzki, 2006b; Parrish et al., 2016). In a recent report, the Public Health Association of Australia (PHAA) referred to the environmental impacts of food systems, stating:

... the food system (production, processing, packaging, distribution, retailing, consumption and waste management) is linked to the environment through a range of inputs at each stage and outputs are returned to the environment as greenhouse gases, waste water, packaging and food waste, as well as land degradation and loss of biodiversity (Public Health Association of Australia [PHAA], 2015b: 1).

A recent book, *Food literacy* (Vidgen, 2016), has highlighted the importance of knowledge about food production systems and the effects of consumption on the environment to inform food choice behaviours.

Only a few researchers have explored and identified the importance of food systems education (e.g. Harmon and Maretzki, 2006a; Parrish et al., 2016; Ronto et al., 2016b). Consequently, very few studies have explored adolescents' knowledge of food systems issues. Two exceptions are Harmon and Maretzki's (2006b) study of food systems knowledge and attitudes in US high school students, and Ronto and colleagues' study of adolescents' views on food literacy

(Ronto et al., 2016a), which explored Australian adolescents' perceptions of the importance of knowledge of food systems issues. The number of studies that assessed individuals' knowledge of a broad range of nutrition issues in conjunction with food systems issues is even more limited. The exception is an Australian study of adolescents' views on food literacy and its impact on their behaviour (Ronto et al., 2016a). This research will address these gaps in N&FS studies, as well as knowledge of nutrition issues in conjunction with food systems issues.

2.1.3 School setting and nutrition education

Schools are widely accepted as having the potential to make substantial contributions to promoting healthy eating habits in children and adolescents (Rowe et al., 2010: 197).

It has been established that school settings provide a great opportunity to deliver food-related education programs for children and adolescents and even school staff and parents (Pérez-Rodrigo and Aranceta, 2001). The Food and Agriculture Organization (FAO) reinforced the view that the school setting was a “natural development zone” for food and nutrition education and a key social context for lifestyles development (Food and Agriculture Organization [FAO], 2005).

Schools are identified as a main environment for children to learn about food, and to build food preferences, when they start going to school (Pérez-Rodrigo and Aranceta, 2001). Subsequently, some researchers have highlighted the importance of providing food-related education programs within school settings to increase students' chances of behaviour change (Harmon and Maretzki, 2006a). These researchers noted that nutrition education programs for children need to be multidimensional and should promote students' involvement in the selection, preparation and tasting of food. These researchers acknowledged that such experiential learning required appropriate school policies, proper facilities and sufficient funds to increase students' engagement in food experiences within the school setting (Harmon and Maretzki, 2006a).

Studies from both developed and developing countries have reported schools are not using their potential to deliver the required food and nutrition education programs (Kann et al., 2007; Kazemian et al., 2014; Carraway-Stage et al., 2015). For example, in 2006 it was reported that more than 70% of US states mandated that their schools educate students about nutrition, yet students had received only approximately four hours of nutrition education per year (Kann et al., 2007). Carraway-Stage and colleagues (2015) emphasised the importance of providing at least 10 to 15 hours of classroom-based nutrition education to create medium effects on students' knowledge. Schools thus have the potential to provide N&FS education programs, even if this does not yet translate into standard practice. This research aims to focus on N&FS education within the school setting.

2.2 Part 2: Review of essential nutrition and food systems issues for school-leavers

2.2.1 Literature review research questions

N&FS knowledge/education is important for adolescents and other population groups, and school environments have been identified as offering great potential as settings to advance such knowledge. This review of the literature focuses on outlining what scholars have identified as the spectrum of NFS knowledge deemed to be important to impart during schooling, effective strategies to impart such knowledge, and success factors of those strategies. The review findings provide important background information for the subsequent exploration, in which food experts will deliver their views on the N&FS knowledge that it is important for young people to attain during their schooling, and on how best to undertake such education.

The literature review addresses the following questions:

- 1) What are the important N&FS knowledge issues for school-leavers?
- 2) What is the current status of school-leavers' knowledge regarding N&FS issues?

- 3) Which strategies improve school-leavers' knowledge of N&FS while they are engaged in the formal education system?

2.2.2. Search strategy for this literature review

Electronic literature searches were conducted to explore the three literature review research questions listed above. To identify the relevant literature, a range of databases were searched, including:

- Google Scholar
- MEDLINE
- SCOPUS
- ScienceDirect
- Thomson Reuters Web of Science
- Academic Search Complete
- ProQuest Central
- PubMed Central
- Cochrane Database of Systematic Reviews
- Wiley Online Library.

Separate searches using different key words were undertaken to answer each research question.

For the first research question, "What are the important N&FS knowledge issues for school-leavers?", the key terms were:

- knowledge
- nutrition
- food system*
- school-leaver*
- young adult*.

Searches were conducted on these terms together with other key words that had close relationships with them, such as:

- understanding
- awareness
- education
- literacy
- food
- young adult*
- youth
- adolescent
- teenager*
- youngster*.

For the second research question, “What is the status of current knowledge of school-leavers’ regarding N&FS issues?”, the probed key terms were:

- knowledge
- nutrition
- food system*
- school-leaver*

together with other key words that had close relationships with these terms, such as:

- understanding
- awareness
- education
- literacy
- food
- young adult*
- youth
- adolescent
- teenager*
- youngster*
- school*.

For the third research question, “What are the best strategies to improve school-leavers’ knowledge of N&FS during formal education system?”, the key search terms were:

- strateg*
- school-leaver*
- knowledge
- nutrition
- food system*
- school*.

Other close key terms used were:

- approach*
- method*
- polic*
- plan*
- tactic*
- scheme*
- understanding
- awareness
- education
- literacy
- food
- young adult*
- youth
- adolescent
- teenager*
- youngster*
- understand
- school.

To identify the most relevant articles, the key terms were used together with the Boolean operators “and” and “or” as conjunctions to combine key terms in a search. The search processes for the first and second research questions were the same. In fact, the first and second research questions used similar key terms, so they were investigated in unison.

Core issues in the N&FS knowledge domain (e.g. food safety, food labelling, cooking) were identified first, and publications related to these issues were then sourced separately. After each core issue was identified, appropriate articles related to that specific issue were found before moving on to the next core N&FS issue.

In addition, official Australian and international websites and Australian government webpages were explored for relevant information from existing factsheets or reports, including WHO, PHAA and the Australian Bureau of Statistics (ABS). Official Iranian websites were not explored through this literature review, as access to them was problematic: it is not government policy to make reports publicly available. Hence, it would not have been possible to determine the comprehensiveness of such a search. In addition, this literature review was limited to sources published in English.

2.2.2.1 Inclusion criteria for selected literature

Results were included for examination in the literature review if they:

- directly addressed knowledge or literacy or education regarding N&FS issues
- were written in English (well-recognised Iranian journals also publish in English)
- focused on young adult population groups (however, in some areas, due to the scarcity of existing literature related to the young adult/adolescent population group, studies that related to other population groups were also incorporated into this literature review).

No time period criteria was considered for this research, due to the scarcity of literature in some fields.

2.2.3. Important nutrition and food systems knowledge issues for school-leavers, and the status of their knowledge about these issues

This part of literature review presents the literature that was identified as relating to the first and second research questions:

- What are the important nutrition and food systems (N&FS) knowledge issues for school-leavers?
- What is the current status of school-leavers' knowledge regarding nutrition and food systems (N&FS) issues?

Significant issues were identified in relation to school-leavers' knowledge of N&FS, and the status of their knowledge about these issues. A flowchart revealing the process of literature selection for this part of the review is shown in Figure 2.1 below.

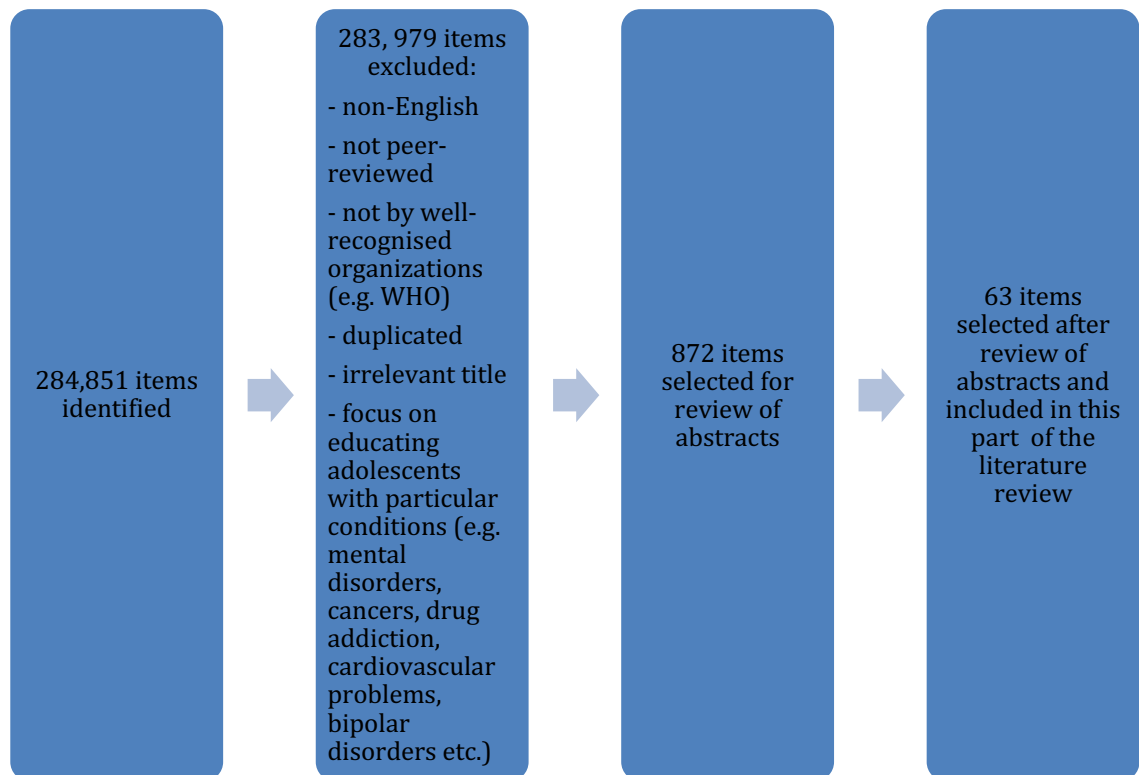


Figure 2.1 Literature selection for part 1 of the literature review

Identified issues necessary to acquiring knowledge of N&S included:

- general nutrition knowledge
- food preparation and cooking skills
- gardening skills
- food safety knowledge
- reading and understanding food labels
- food systems knowledge
- farm animal welfare.

Each of these issues was separately explored to identify further relevant studies. Literature informing each of these aspects of N&FS knowledge are explained in the following sections.

2.2.3.1 General nutrition knowledge

The importance of “general nutrition knowledge” (Parmenter and Wardle, 1999; Hendrie et al., 2008b; De Vriendt et al., 2009) has been highlighted in the literature to improve the capacity of individuals to choose a healthy diet (Liao and Lai, 2017) or, more generally, to promote healthier dietary behaviours (Parmenter and Wardle, 1999; Hendrie et al., 2008b; De Vriendt et al., 2009). The concept of “general nutrition knowledge” was described by Parmenter and Wardle (1999) in the context of a reliable nutrition knowledge questionnaire. The content of this instrument included awareness of dietary recommendations, food sources of nutrients, daily food selections and nutrition-related health problems (Parmenter and Wardle, 1999). This questionnaire has been used in many subsequent studies and has been validated as a knowledge assessment questionnaire for various population groups in different countries (e.g. Hendrie et al., 2008b; De Souza et al., 2015; Bukenya et al., 2017). Further, other nutrition investigators, such as Zoellner et al. (2009), Gibbs and Chapman-Novakofski (2010) and Liao and Lai (2017), have highlighted the importance of consumers’ awareness of general nutrition issues, including of macronutrients, estimation of portion sizes, food groupings (Gibbs and Chapman-Novakofski, 2010), and dietary guidelines (Zoellner et al., 2009).

Australian studies on general nutrition knowledge

A recent qualitative study by Ronto and colleagues (2016a) explored 131 Australian adolescents’ perceptions of food knowledge through 15 focus groups. Participants reported that knowledge of dietary guidelines, the required servings of different foods, and healthy versus unhealthy foods was very important (Ronto et al., 2016a). Another Australian study (Hendrie et al., 2008a), of 201 adults (aged >17 years), identified participants had a good understanding of

dietary messages related to the consumption of fruits and vegetables, and limiting salty and fatty foods. However, their participants were confused about more detailed nutrition concepts. For example, while 90% of the participants were aware of the need for a higher intake of fruits and vegetables, only 60% knew about the recommended number of servings of fruits and vegetables. Hendrie and colleagues (2008a) indicated that there was significant variation in individuals' levels of nutrition knowledge, based on demographic factors such as age, gender, education and employment status. These investigators concluded that, while there was insufficient knowledge among the Australian public of some nutrition recommendations, their knowledge varied significantly based on demographic factors (Hendrie et al., 2008a).

Iranian studies on general nutrition knowledge

A study of the knowledge and practices of 4,987 rural households and 9,149 urban households in 31 provinces of Iran in relation to general nutrition issues was conducted in 2011–12. The data was collected through structured questionnaires and interviews with the mothers, or another member of the household who was above 15 years of age and responsible for cooking and meal preparation. Findings revealed that approximately 50% of rural and 57% of urban households had knowledge of food groups. However, smaller proportions (40% of rural and 35% of urban households) had accurate knowledge about the roles of food groups and health (Ahadi et al., 2014). This study supported the need for further education of Iranian population groups about nutrition.

2.2.3.2. Cooking skill knowledge

Development of cooking skills has been introduced as a strategy to reduce nutrition-related chronic conditions and diseases for different population groups, including children, teenagers and adults (Lavelle et al., 2016). The need for adolescents to build food preparation and cooking skills to support healthier eating behaviour has been frequently reported in literature (Fordyce-Voorham, 2011a; Brooks and Begley, 2014; Santarossa et al., 2015; Ronto et al., 2016b). In

a study of cooking activities among adolescents, Santarossa and colleagues (2015) reported:

... food preparation during adolescence was associated with positive eating behaviors into young adulthood, however, only 69% of adolescents reported ever helping to prepare dinner, and two-thirds of those reported helping less than 3 times/week. Involvement in food preparation has been associated with improved overall diet quality (Santarossa et al., 2015: 945).

A recent Irish study of cooking skills was conducted among 1,049 adults aged between 20 and 60 (Lavelle et al., 2016). The findings from the cross-sectional survey included that it was important for individuals to learn this skill at an early life stage, for “skill retention” and to ensure confidence and a positive attitude toward cooking. The authors noted that mothers had been the main source of obtaining cooking skills. However, due to a lack of cooking skills among the women participants, contemporary mothers were unable to teach cooking, or have an impact on the next generation’s cooking competencies (Lavelle et al., 2016).

Australian studies on cooking skills

Cooking skills have been identified as necessary for young adults to become capable of independent living (Fordyce-Voorham, 2011). The development of cooking skills assisted individuals to select and apply appropriate methods of cooking (Fordyce-Voorham, 2011). Cooper and Begley also reported that cooking skills were essential for the prevention of nutrition-related health problems (Cooper and Begley, 2011). These researchers noted that young people should build their food preparation skills so as to decrease their likelihood of consuming convenience foods (Cooper and Begley, 2011). A survey of 355 low-socioeconomic women in Australia reported participants’ confidence in preparing vegetables had a positive correlation with their purchase of them (Winkler and Turrell, 2010). A study of Australian adult Indigenous populations (Abbott et al., 2010) identified barriers and motivations in relation to the

effectiveness of cooking intervention programs, including a lack of family support, oral health problems, depression, budget constraints, and food preferences as barriers; family support and new health diagnoses like diabetes, heart disease or cancer were identified as motivational factors (Abbott et al., 2010).

Iranian studies on cooking skills

No studies exploring cooking skill interventions among Iranian population groups were identified through this review of the literature. Due to the importance of the role that cooking activities may play in adolescents' nutrition education programs (Fordyce-Voorham, 2011; Brooks and Begley, 2014; Santarossa et al., 2015), Iranian researchers may need to consider this critical gap in future Iranian studies on adolescents.

2.2.3.3. Gardening skills

There has been a recent increase in studies assessing school-based gardening activities and their potential links to increased healthier eating behaviours and physical activity among students (Ohly et al., 2016). A study of school gardens in primary and secondary schools in New Zealand referred to gardening programs as an "important health promotion tool" for schools (Collins et al., 2015). The study showed that, among 491 schools in New Zealand, 53% had gardens with edible crops, and most of the gardens had been built since 2013. The most commonly grown crops in school gardens were fruit trees, vegetables and herbs (Collins et al., 2015). Gardening programs had also been integrated with cooking lessons and curriculum subjects (Collins et al., 2015).

A recent review of gardening interventions reported evidence of the potential positive impacts of school gardening programs on dietary practices of students, particularly in relation to fruit and vegetable consumption (Berezowitz et al., 2015). Also in New Zealand, a national study (Utter et al., 2016) indicated the effects of school gardens on adolescents' BMIs and dietary behaviours. In 8,500 secondary schools there was a positive association between school garden

activities and lower BMIs ($p=0.01$), a lower prevalence of overweight ($p<0.01$) and less fast food intake among students involved in school gardens (Utter et al., 2016). The study found school gardens achieved greater impacts with students from lower socioeconomic population groups (Utter et al., 2016).

Australian studies on school gardening practices

The majority of Australian studies focused on school gardening programs for primary school students (Jaenke et al., 2012; Gibbs et al., 2013; Yeatman et al., 2014), as opposed to secondary school students. For example, Gibbs and colleagues examined the impact of the Stephanie Alexander Kitchen Garden program on 764 children aged 8 to 12 (Gibbs et al., 2013) over a 30-month period. The study showed students spent 45 to 60 minutes in gardening activities during each week of the year and revealed improvements in children's willingness to try new food products (Gibbs et al., 2013). Another Australian study, of 127 children aged 11 to 12 years (46% girls; 54% boys), investigated the impacts of school gardening practices on the fruit and vegetable intake of boys and girls. No significant difference was identified in either genders' intake of fruits and vegetables, with the exception of carrot consumption in girls (Jaenke et al., 2012).

Iranian studies on school gardening practices

No published studies were found regarding school-based or community-based gardening activities among different population groups of Iranian adolescents.

2.2.3.4. Food safety knowledge

Millions of people die annually and many are hospitalised because of foodborne diseases related to the consumption of contaminated foods (Osaili et al., 2011). Studies show that 50% to 87% of foodborne illness outbreaks arose from domestic food handling (Unusan, 2007). Food safety knowledge has been found to be associated with domestic food handling risks and unhealthy eating behaviours, underlining the importance of consumers' knowledge of the

procedures required to prevent foodborne illnesses at home (Unusan, 2007; Byrd-Bredbenner et al., 2008; Osaili et al., 2011).

Australian studies in food safety knowledge

In Australia, more than five million cases of foodborne illnesses have been estimated to occur each year (Mullan and Wong, 2010). Approximately 10% to 20% of these foodborne illnesses were related to food handling practices among consumers (Mullan and Wong, 2010). Proper handling during food preparation and storage are critical to reducing foodborne illnesses (Mullan and Wong 2010).

Young adults in Australia have limited knowledge of food safety and have been found to be more engaged in risky behaviours associated with food hygiene than other groups of the population (Mullan and Wong, 2010). In a study of 2,022 Australian adults, Worsley et al. (2013) identified relatively poor knowledge of food safety among participants. Knowledge of food safety was associated with gender, age, education and health education or home economics education at schools (Worsley et al., 2013). Interestingly, in a recent Australian study by Ronto and colleagues, adolescents identified knowledge of food safety and food hygiene as an essential component of food literacy for themselves (Ronto et al., 2016a). Another recent survey of 475 secondary school and university students in Australia and the UK reported participants' very low levels of food safety knowledge (Mullan et al., 2015). In this survey, the secondary school students achieved a mean score of only 38%, and the mean score for university students was 54% (Mullan et al., 2015).

Iranian studies on food safety knowledge

In Iran, foodborne illness has been reported; however, few studies have examined Iranians' food safety knowledge. Between 2006 and 2011, 2,250 foodborne outbreaks were reported, with approximately half (55%) of those cases occurring in rural areas of Iran. Young people aged 16 to 30 and females were more affected (Asl et al., 2015). A study conducted after an outbreak of diarrhoea in one of the provinces of Iran revealed that the non-affected

communities had a greater understanding of foodborne and waterborne illnesses (Cheraghi et al., 2014).

2.2.3.5. Food systems knowledge

Over recent decades, food and nutrition researchers have identified the importance of educating people about food system issues (Harmon and Maretzki, 2006b; Parrish et al., 2016; Vidgen, 2016). The food system has been defined:

... as the process of food production, distribution, preparation, and preservation; food use and consumption; the recycling and disposal of food wastes; and the systems that support this process including marketing, transportation, storage, and government services (regulation, research, and extension) (Harmon and Maretzki, 2006a: 91)

The increased recognition of the importance of food systems knowledge has been linked to trends such as global population growth and diet transition toward increasing consumption of animal protein. These trends highlight the need for agricultural and food systems which are both productive and sustainable, including consumers' understanding of these connections and their own food choice behaviours (Spiertz, 2010).

Some studies have specifically identified the importance of agri-food system education (Trexler et al., 2000; Hess and Trexler, 2011; Worsley et al., 2015a). In particular, Hess and Trexler noted:

... modern agriculture poses ecological problems and opportunities, which defy simple democratic reform without an educated citizenry. Developing an educated citizenry can be accomplished by further developing agricultural literacy in elementary education (Hess and Trexler, 2011: 151).

In a study of 1,026 Australian adults, Worsley and colleagues also identified the low level of participant knowledge of agriculture and raised the need for schools and higher education settings to deliver education programs incorporating agriculture into the curriculum (Worsley et al., 2015a).

In the food systems knowledge domain, Harmon and Maretzki (2006b) noted that community awareness of sustainability, in conjunction with encouraging consumers to select foods that are locally produced and processed, was necessary to preserve fossil fuels, support family farms and rural communities, reinforce local economies, and sustain food production. Local and seasonal foods have been associated with community economic growth, environmental sustainability and human nutrition (Wilkins, 2005). Thus, educating the public on local and seasonal foods was essential to develop a sustainable food system and diet (Wilkins, 2005). Another study explored the food systems knowledge and attitudes of 295 high school students in the US (Harmon and Maretzki, 2006b). It identified that participants had a limited knowledge of agriculture, sustainability and food systems, and a better knowledge of food sources, nutrition, food safety, hunger and local foods. Participation in gardening and food practices at home was positively associated with food systems knowledge (Harmon and Maretzki, 2006b).

Knowledge of food systems has also been linked to promoting informed food choices that are supportive of food ethics (Harmon and Maretzki, 2006d; Parrish et al., 2016). Awareness of food ethics, such as food choices associated with environmental sustainability and natural resources (Harmon and Maretzki, 2006d; Parrish et al., 2016), has received further attention in nutrition education literature over recent years. Incorporating “food systems knowledge” as a focus in the current research might assist in identifying a range of important food systems knowledge issues for young adults which could be integrated into their school-based education programs.

Australian studies on food systems knowledge

Very recently, Australian investigators have shown particular interest in food systems literacy. A study by Ronto and colleagues (2016a) explored food literacy levels among Australian adolescents (N=131) through 15 focus groups, which included both quantitative and qualitative questions and identified participants’ poor knowledge of environmental sustainability and animal welfare. In a recent

edited book on food literacy developed by Australian food researchers, it was reported that some understanding of agri-food and environmental issues associated with food production was essential to be included in school-based education programs (Vidgen, 2016). In contrast, in a recent cross-sectional study of 205 home economics teachers in Australia, participants identified food systems knowledge areas such as animal welfare issues and sources of foods as the least important knowledge areas for adolescents (Ronto et al., 2016b). Studies assessing the views of other relevant professionals, such as public health nutritionists and environmental scientists, may assist in determining the importance of farm animal welfare and food-related environmental sustainability issues for adolescents.

Iranian studies on food systems knowledge

No studies were identified that investigated essential components of food systems knowledge for Iranian population groups. Further, no research assessed Iranians' knowledge of food systems issues across all population groups.

2.2.3.6. Food label knowledge

Food labels are considered a cost-effective strategy to communicate to consumers important information about the nutritional content of particular food products (Miller and Cassady, 2015). However, research indicates that food labels are complex and not always easy to understand (Hieke and Taylor, 2012). A review from the US and Canada (Temple and Fraser, 2014) explored food label use and reported that most consumers had difficulty reading and understanding front-of-pack and back-of-pack food label information (Temple and Fraser, 2014).

Research has identified the necessity for young adults to have food label knowledge to support informed dietary choices (Misra, 2007; Sharf et al., 2012). A study of 120 young adults in Israel identified insufficient food label knowledge among young adults, and highlighted the need for a combination of strategies, including educational interventions, and the simplification and standardisation

of food labels (Sharf et al., 2012). An interesting finding of this study was that participants' perceptions of their own knowledge was considerably higher than their actual knowledge (only 27% received high food knowledge scores, when 44% had indicated they understood food labels very well) (Sharf et al., 2012). A review of "the effects of nutrition knowledge on food label use" found that knowledge of nutrition was supportive of food label use (Miller and Cassady, 2015: 207). In this area, a study of 537 US college students revealed that superior nutrition knowledge and positive attitudes affected the use of food labels among young adults (Misra, 2007).

Australian studies on food label knowledge

Poor understanding of information on food labels has been found to negatively affect young adults' willingness to read food labels (Ronto et al., 2016a). An Australian study explored the awareness of energy terms on food packaging by interviewing 40 adult shoppers and surveying 405 adult shoppers in two Sydney supermarkets (Watson et al., 2013). Findings revealed the shoppers had poor knowledge of kilojoules and energy (Watson et al., 2013). Participants assumed that food products with higher energy content provided sustained energy and were healthier. For example, breakfast cereals with higher energy content were perceived as healthier options (Watson et al., 2013). A recent Australian study exploring the views of 131 adolescents indicated that participants did not read the information on food packages due to a lack of understanding of the information and how to identify the specific details of food labels they needed (Ronto et al., 2016a). The research also reported a lack of interest in food label information (Ronto et al., 2016a). A review of Australian and New Zealand consumers' understandings and use of nutrition labels showed that consumers had limited observed or actual understanding of nutrition label information, and their use of this information was limited (Mhurchu and Gorton, 2007).

The results reported thus far indicate a need for young Australians to be educated about food label information. This in turn may encourage and enable them to

read food labels and hence access the information they need to inform their food choices.

Iranian studies on food label knowledge

One Iranian study examined the food label use and understanding of 332 university students aged 18 to 25 (Mahdavi et al., 2012). Study participants were selected from university students undertaking different study majors, including public health, nutrition, paramedical, health services administration and engineering. It was reported that the majors of the students significantly related to their knowledge, attitudes and use of food labels (Mahdavi et al., 2012). The study found that approximately 77% of the participants reported they found food labels to be useful; however, around 80% did not feel the nutrition claims were truthful. The majority of the participants (84%) reported that most important information on food labels related to the “storage conditions” and expiry date (Mahdavi et al., 2012). Of the 48% of students who noted they regularly used the “nutrition facts label” when shopping, only 32% used food labels for their daily eating planning (Mahdavi et al., 2012), and fatty acids were considered the least important information (around 2%) on food labels. The investigators of this study recommended education programs to improve knowledge of food labels among Iranian students (Mahdavi et al., 2012).

2.2.3.7. Farm animal welfare

Increasing consumers’ awareness of farm animal welfare may positively affect the purchasing behaviour of animal welfare friendly food products (Taylor and Signal, 2009; Miranda-de la Lama et al., 2017). Intensive livestock production systems have been strongly criticised by different sectors of society, particularly in Australia, Europe and the US, resulting in civil action and protests, including farm animal rights campaigns and movements (Miranda-de la Lama et al., 2017). Consumers’ concerns regarding farm animal welfare and animal rights have been reported to affect the way farm animals are treated in the livestock sector (Miranda-de la Lama et al., 2017).

Knowledge of the food system as it relates to farm animal welfare is potentially important to encourage people to buy more animal welfare friendly food products (Ronto et al., 2016a; Ronto et al., 2016b). A quantitative study explored the association between the participant consumption of animal products and attitudes toward animal welfare among 16,777 university students in Europe and Asia (Izmirli and Phillips, 2011). Results revealed that 47% of participants avoided some types of meat products, 4% were vegetarians and 0.4% were vegans. Students' reasons to avoid some meat products were mainly related to health and environmental issues (Izmirli and Phillips, 2011). The most common meats avoided were lamb and beef. Avoiding the consumption of meat products was associated with increased concern regarding wildlife, animal rights and animal testing, with vegans showing the greatest concern (Izmirli and Phillips, 2011). Similarly, a study in Ireland (Share and Stewart-Knox, 2012) found that "animal rights" was one of five key food selection motivations among 394 adolescents aged 14 to 17 (Share and Stewart-Knox, 2012).

Australian studies on knowledge of farm animal welfare

A recent study of 131 Australian adolescents aged 12 to 17 (Ronto et al., 2016a) revealed participants' knowledge of animal welfare in relation to food production systems was limited. Most participants assumed animal welfare referred to being a vegetarian. Only a limited number of adolescents were aware of key issues such as cage-free versus caged chickens for egg production (Ronto et al., 2016a). In contrast, a study of 2,204 Australian adults (Worsley et al., 2015b) identified concerns among participants for animal welfare, including issues relating to "animals being treated cruelly during food production" and "the slaughtering of livestock for meat production" (Worsley et al., 2015b: 50). Another Australian study, of 1,224 community members, investigated consumers' willingness to pay for farm animal welfare friendly products (Taylor and Signal, 2009). In that study, self-rated knowledge of farm animal welfare was associated with a willingness to pay for farm animal welfare friendly products (Taylor and Signal, 2009), indicating a potential link between knowledge of animal welfare and food choice behaviours.

Iranian studies on farm animal welfare knowledge

No studies exploring Iranian consumers' awareness of farm animal welfare, or their willingness to pay for animal welfare friendly products, were identified.

2.2.4. Food literacy literature

“Food literacy” is a term frequently used in studies exploring N&FS knowledge (e.g. Bellotti, 2010; Vidgen and Gallegos, 2014; Cullen et al., 2015; Ronto et al., 2016a; Ronto et al., 2016b). Cullen and colleagues defined food literacy as:

... the ability of an individual to understand food in a way that they develop a positive relationship with it, including food skills and practices across the lifespan in order to navigate, engage, and participate within a complex food system. It's the ability to make decisions to support the achievement of personal health and a sustainable food system considering environmental, social, economic, cultural, and political components (Cullen et al., 2015: 143).

Cullen and colleagues (2015) considered several components associated with food literacy, including food impacts on health and wellbeing; food production from farm to consumption and waste; and knowledge of the food systems, such as social, environmental, political and economic factors.

Researchers have incorporated a range of other issues within their exploration of food literacy. Bellotti identified food literacy in a multidimensional context, considering “social development and equity” in addition to the above definition of Cullen and colleagues (Bellotti, 2010). This range of issues reflects the focus of this research, with its inclusion of farm animal welfare. Other food literacy studies have taken a more limited approach to food literacy and primarily focused on the health and wellbeing aspects of nutrition knowledge (Kolasa et al., 2001; Pendergast and Dewhurst, 2012).

A very recent Australian study investigated the importance of some components of food literacy from the perspective of home economics teachers (Ronto et al., 2016b). Teachers in this study rated cooking, food safety and knowledge of

healthy foods as the most important aspects of food literacy. Food sources, animal welfare and shopping skills were rated as the least important components of food literacy (Ronto et al., 2016b). Notably, these perceptions were limited to one professional group. Research that included a wider range of food educators or professionals from different food professions would likely affect reported perceptions regarding the importance of food systems education for young adults. Another study by Ronto and colleagues explored 131 Australian adolescents' views of food literacy (Ronto et al., 2016a). Australian adolescents in that study reported that they considered nutrition knowledge issues were more important than food skills. Moreover, participants showed very limited understanding of the relevance of environmental sustainability and animal welfare to food literacy (Ronto et al., 2016a). This may highlight the need to improve adolescents' broad understanding of food, incorporating environmental sustainability and animal welfare to food literacy.

The term "food literacy" and its essential components for Iranian population groups has not been reported on by Iranian researchers.

In summary, this section of the literature review provided an overview of the broad range of nutrition and food systems knowledge issues that have been identified in the literature as important for different population groups, particularly young adults. Equipping adolescents with N&FS knowledge should assist them to make informed food selections, primarily to improve health-related dietary behaviours, but also to reflect positive attitudes relating to environmental sustainability, farm animal welfare and ethical food production practices.

A number of gaps were identified in this search of the literature. Globally, literature focusing on the broad range of N&FS knowledge issues, particularly within the one study, was limited. There was also a paucity of N&FS knowledge studies from Iran. This research project aims to address these gaps in the literature.

This literature review provided insights into some of the potential food knowledge issues that Australian and Iranian food professionals may recommend as important food knowledge to adequately prepare adolescents for a healthy future. Identified areas included:

- general nutrition knowledge, in order to be able to select healthy foods to improve dietary behaviour, and decrease nutrition-related health problems
- cooking and gardening skills, to encourage healthy dietary behaviours and to increase consumption of fruits and vegetables
- food safety knowledge, to decrease foodborne illness outbreaks
- food systems knowledge, in conjunction with ethical considerations such as environmental sustainability and animal welfare
- food label knowledge, to assist consumers in making informed dietary choices.

2.3. Part 3: Strategies to improve adolescents' knowledge of nutrition and food systems in formal education

The second section of this literature review relates to the third research question:

- What are the best strategies to improve school-leavers' knowledge of N&FS during the formal education system?

A flowchart revealing the process of literature selection for part 2 of the literature review is shown in Figure 2.2 below.

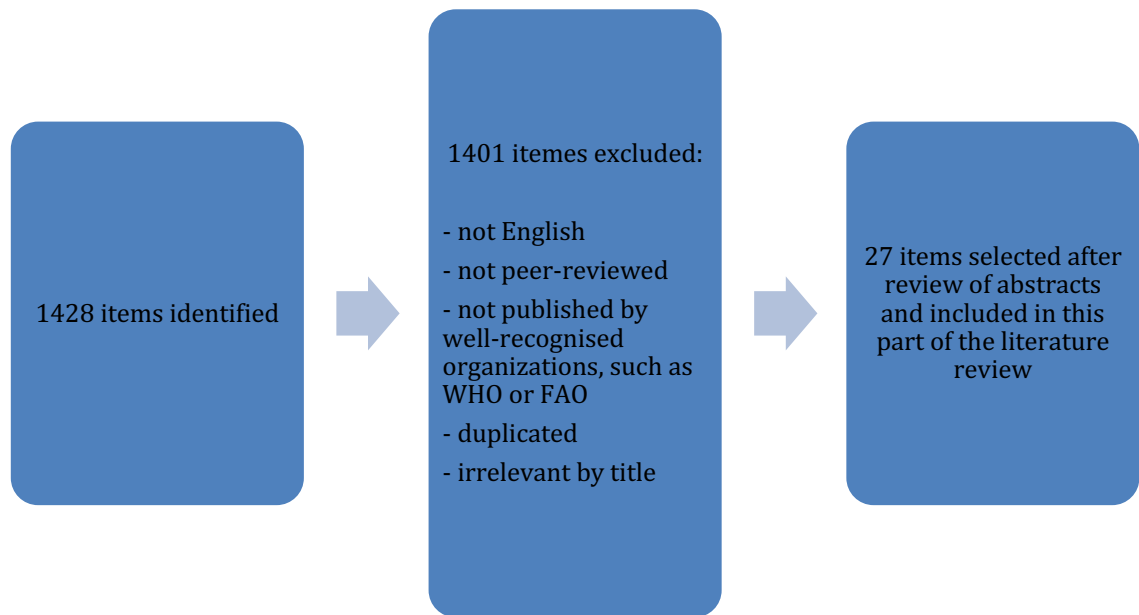


Figure 2.2 Literature selection for part 2 of the literature review

Overall, a lack of studies focused on appropriate strategies to educate adolescents regarding important N&FS issues. However, a systematic review and meta-analysis of teaching strategies that aimed to improve healthy dietary behaviour in primary school children (Dudley et al., 2015) identified several key teaching strategies, including:

- improvements in the curriculum
- cross-curricular activities
- parent involvement
- experiential initiatives (gardening and cooking practices)
- reward based approaches
- games and web-based education (Dudley et al., 2015).

Some strategies that were identified as positively affecting school-leavers' knowledge of N&FS are described separately in the following paragraphs.

2.3.1. Integrative curriculum approach

Some success has been reported in integrating nutrition lessons with other subjects in primary school education (Gortmaker et al., 1999; Aranceta et al., 2003; Carraway-Stage et al., 2015). By integrating nutrition lessons with other subjects, students were able to receive more education on nutrition issues, which can positively impact their level of knowledge on nutrition (Carraway-Stage et al., 2015). Studies that explored the effects of an integrative curriculum approach on school students' knowledge of N&FS were limited in number.

One study from the US (Carraway-Stage et al., 2015) reported that, annually, primary school students received approximately four hours of nutrition instruction (before the intervention under examination). These investigators integrated food topics into maths and science in 18 classrooms of grade 4 students and considered 16 classrooms as comparisons, and evaluated students' nutrition knowledge at baseline and post intervention (Carraway-Stage et al., 2015). Findings revealed a significant increase in students' knowledge of nutrition in the intervention group compared to the control (Carraway-Stage et al., 2015).

In another US study in the primary school setting, teachers integrated nutrition and physical activity programs into science, maths, social studies, arts and language over two years (Gortmaker et al., 1999), aiming to increase students' intake of fruits and vegetables, decrease consumption of high-fat foods (and saturated fats), increase physical activity, and reduce television watching. Study results showed improved participant eating patterns from baseline to follow-up (Gortmaker et al., 1999). Measured by 24-hour recall, there was a reduction in calorie intake from saturated fat and total fat, and increases in the consumption of fruits, vegetables, fibre and vitamin C. Watching television was also reported to be slightly reduced (Gortmaker et al., 1999). However, self-reports of food intakes and behaviours have been found to be quite unreliable (Macdiarmid and Blundell, 1998), and it is notable that similar results have not been subsequently reported.

Integrating N&FS topics with other core subjects could be a potential strategy to improve food knowledge in Australian and Iranian adolescent research, but it would be desirable to have more evidence of the effectiveness and impact of this strategy.

2.3.2. Employing a wide range of teaching methods in schools

Selection of appropriate methods of food and nutrition education needs to reflect the desired learning objectives (Perez-Rodrigo and Aranceta, 2001; Perez-Rodrigo and Aranceta, 2003). Studies have reported that a wide range of nutrition education methods can be used for school-based education programs, such as classroom discussions, developing food records, shopping activities, taste experiences and drama (Perez-Rodrigo and Aranceta, 2001; Pérez-Rodrigo and Aranceta, 2003). Other methods include gardening activities, cooking courses, and food workshops and exhibitions (Perez-Rodrigo and Aranceta, 2003).

The WHO's Information Series on School Health (WHO, 1998) included various teaching techniques (e.g. debates, discussions, lectures, role-play, audiovisual) that should be used to improve knowledge, skills, attitudes and beliefs to support building healthy lifestyles in students (WHO, 1998). The WHO also recommended that the selection of education methods reflect the desired learning objectives; for example, lecturing techniques were reported to be effective at increasing knowledge but inappropriate to build skills (WHO, 1998). Activity-based teaching (e.g. food preparation, cooking, gardening) in schools was reported to be more appropriate and effective in the development of food-related skills (WHO, 1998). The influence of this information series is not clear, nor is the extent to which countries are familiar with the document or are acting on its guidance.

2.3.3. School-based food skills

Building a range of food skills (e.g. shopping, cooking and gardening) for secondary school education programs to promote healthy dietary practices has been identified as essential (Fordyce-Voorham, 2011). The development of

adolescents' food preparation skills has been reported to equip and prepare them for healthy and independent lives during adulthood (Lai Yeung, 2007). However, an Australian study that explored the views of 131 secondary school students (aged 12 to 17) showed participants' lack of attention to food skill development activities (Ronto et al., 2016a). The participants rated food skills as less important than nutrition knowledge. In addition, participants rated budget management and shopping skills as the least important components of food literacy education (Ronto et al., 2016a).

2.3.4. Game-based nutrition education programs at schools

A few studies have explored and identified educational games as an appropriate method to be used at schools to increase children's and adolescents' nutrition knowledge and to improve food intake behaviour (e.g. Amaro et al., 2006a; Sharma et al., 2015). A study of 107 children in grades 4 and 5 examined the acceptability and effects of a computer game on dietary behaviours and physical activity (Sharma et al., 2015). The intervention group played the game for approximately 4.5 hours over six weeks. Findings revealed a promising acceptability and significant decrease in self-reported sugar intakes ($P=0.021$) and significant positive impacts on nutrition and physical activity attitudes ($P=0.041$) after the intervention.

Some game-based interventions have been used with students aged 14 and under (Amaro et al., 2006), but very few studies have reported implementation of game-based nutrition education interventions for older population groups. An exception is a randomized controlled trial which included a game-based computer program to promote healthy eating among 40 young adults with an average age of 20 (Peng, 2009). The study identified the positive effects of the intervention in teaching weight management, self-efficacy and intention to follow healthy diets. The study reported limited long-term impacts on weight management, while the self-efficacy of the intervention group participants was greater than those in the control group after one month (Peng, 2009). In another study, of 307 students aged 11 to 14, a nutrition board game was used weekly for

15 to 30 minutes for 24 weeks. The study's findings revealed a significant increase in students' nutrition knowledge and vegetable consumption.

Game-based educational interventions offer the potential to increase students' nutrition knowledge and could be considered for use by N&FS educators.

2.4. Part 4: Conceptual and theoretical frameworks

Conceptual, or theoretical, frameworks are a cluster of interrelated concepts and ideas used by researchers to provide structure or a new way of looking at a topic (Ivey, 2015). The focus of this study is to identify a broad range of important N&FS knowledge issues for adolescents and the best strategies to transfer this knowledge. Applying a multifaceted framework in relation to knowledge, learning, education and strategic action planning assisted the research to be both comprehensive and structured. Three frameworks were considered to be relevant to this research project:

- new nutrition science (NNS) framework (Cannon and Leitzmann, 2005; Leitzmann and Cannon, 2005; Lawrence and Worsley, 2007)
- Yang's theory of knowledge and learning (Yang, 2003)
- WHO's Ottawa Charter for Health Promotion (WHO, 1986b).

Each of these frameworks is described separately in the context of each stage of the planned research.

2.4.1. New nutrition science

NNS was proposed in 2005 to provide broader dimensions for nutrition science, as the biological focus of traditional nutrition sciences was considered to be insufficient to address and cope with contemporary food and nutrition challenges (Lawrence and Worsley, 2007); traditional nutrition science primarily addressed the biomedical health dimension of nutrition science and underestimated other aspects of nutrition (Harmon and Maretzki, 2006a). The NNS combined biological nutrition science with social (cultural, political, economic) and environmental aspects of food and nutrition to meet

contemporary food and nutrition challenges (Lawrence and Worsley, 2007a). The approach was a shared initiative of the World Health Policy Forum and International Union of Nutritional Sciences (Cannon and Leitzmann, 2005). It was presented as a new conceptual framework for nutrition science (Cannon and Leitzmann, 2005). This framework incorporated considerations of global concern, such as of human population growth, obesity, diabetes, malnutrition, changes in local and global food supplies, and the reduction of natural resources (Cannon and Leitzmann, 2005). Three key dimensions of this framework are shown in Figure 2.3.

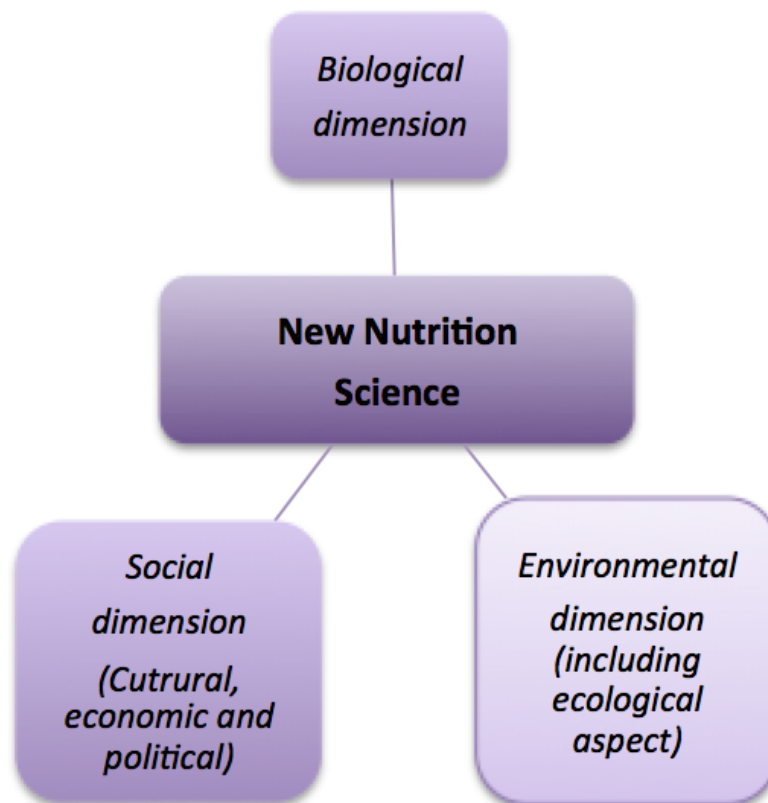


Figure 2.3 The dimensions of new nutrition science

It is notable that the NNS framework recommended generous intakes of plant-origin whole foods and minimal consumption of processed foods (Leitzmann and Cannon, 2005). This approach was supportive of global and local food security (Leitzmann and Cannon, 2005). NNS considered biological aspects of nutrition in

conjunction with social and environmental factors related to food and food systems.

This study focuses on a broad range of N&FS systems knowledge issues, making the NNS framework more relevant than its predecessor.

2.4.2. Yang's theory of knowledge

In a study of knowledge and learning, Yang (2003) developed a holistic model, which included three facets of knowledge: explicit, implicit and emancipatory, in order to “reflect the different processes of knowing” (Yang, 2003: 108). The explicit facet referred to technical knowledge, implicit to practical knowledge, and emancipatory to ethical or value-based aspects (Yang, 2003). Yang proposed that explicit knowledge was sourced from logic and reasoning, and implicit knowledge from experiences and involvement in skill-based practices; emancipatory knowledge was associated with conscious, values and dignity (Yang, 2003).

Yang (2003) noted that learning was understandable through the interactions of these three facets of knowledge (Yang, 2003). Yang claimed that knowledge-based research and theories needed to be included in all three facets of knowledge (Yang, 2003). Yang's facets of knowledge were relevant to the analysis stage of this research, to identify the extent that participants recommended all three facets of N&FS issues for youth. Yang's three facets of knowledge were considered to be directly relevant to NFS knowledge in the following manner:

- scientific nutrition knowledge issues (explicit knowledge)
- practical and skill developing food issues (implicit knowledge)
- value-based food issues (emancipatory knowledge).

Figure 2.4 presents Yang's conceptual framework of knowledge and learning.

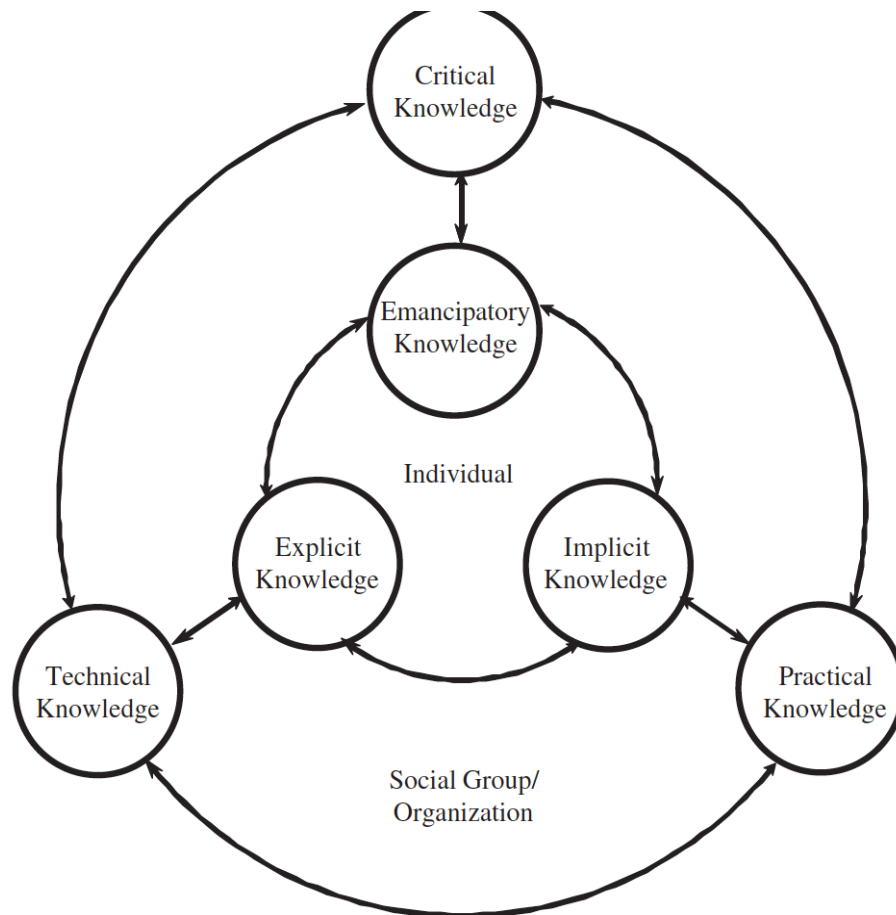


Figure 2.4 A holistic approach for knowledge and learning (Yang, 2003)

2.4.3. Ottawa Charter for Health Promotion

In 1986, a charter was developed at the first International Conference on Health Promotion, held in Ottawa, Canada. The WHO's Ottawa Charter for Health Promotion was built on the Alma-Ata Declaration on Primary Health Care (WHO, 1986a). Since its inception, the Ottawa Charter has directed different public health practices (Nutbeam, 2008).

The Ottawa Charter introduced five action areas for health promotion. The first action area was to “build healthy public policy”, which placed health as an important agenda item for all sectors and acted as a guide for the health-related consequences of their actions, informing sectors of their responsibilities to support health (WHO, 1986b). The second action was to “create supportive environments”, which referred to the complex link between environments and

individuals' health (WHO, 1986b). The third action area was to “strengthen community actions”, which referred to the important role of community-based actions in promoting better health in communities (WHO, 1986b). The fourth action area was to “develop personal skills” by improving people’s life skills to enable them to better manage their own health. The fifth action area was to “reorient health services”, which focused on the shared responsibility of government, health service organisations, community groups and individuals for health promotion (WHO, 1986b).

The action areas of the Ottawa Charter were considered to be of assistance in the current study to develop multidimensional guides for appropriate N&FS education programs for adolescents in Australia and Iran. It also provided structure and helped draw comparisons between the findings from the Australian and Iranian studies.

Figure 2.5 depicts the framework of the Ottawa Charter for Health Promotion.

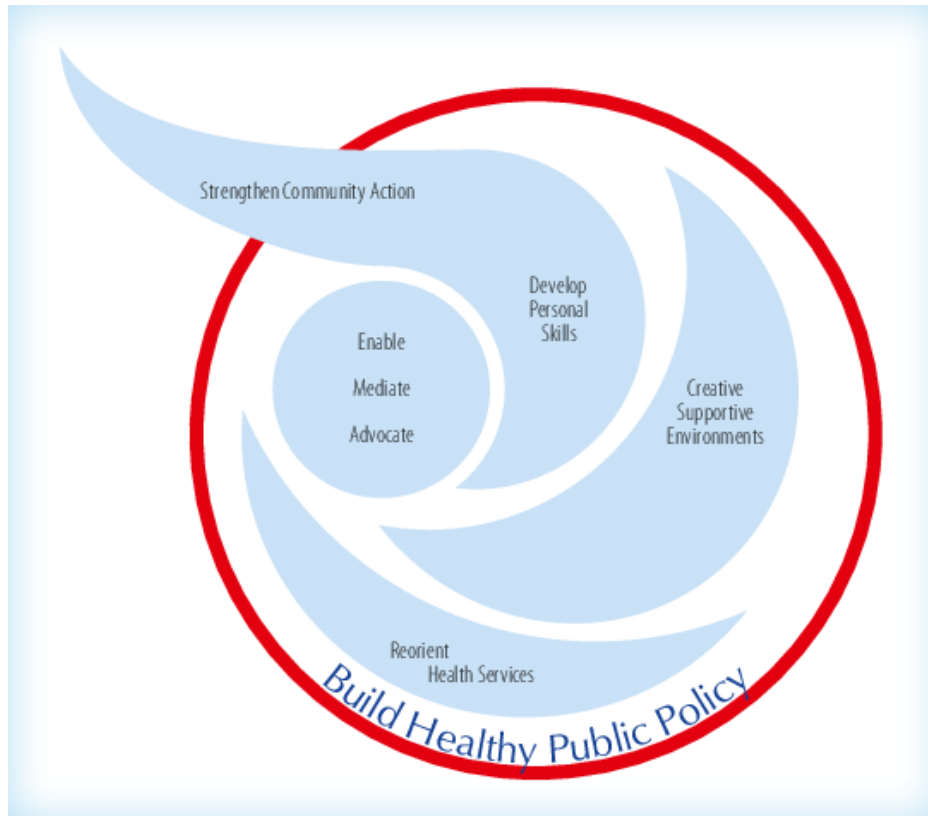


Figure 2.5 Framework for the Ottawa Charter for Health Promotion (WHO, 1986c)

2.5. Conclusion

This chapter described a broad range of N&FS issues of importance to different population groups, particularly adolescents, and what they may learn through the formal education system before leaving school. Areas of required knowledge that were identified included knowledge and skills in the areas of:

- general nutrition
- cooking
- gardening
- food safety
- food systems
- food label
- animal welfare.

It was notable that, globally, only a limited number of studies identified a broad range of essential N&FS knowledge issues within the one investigation. This research aims to address this gap in literature.

Further, a limited number of studies examined the status of adolescents' knowledge of a wide range of important N&FS issues in the one study. This study explores experts' perceptions of the strengths and weaknesses of Australian and Iranian adolescents' knowledge of N&FS more broadly.

The review of the literature also identified that the range of educational strategies that are considered appropriate to assist adolescents to learn about N&FS has not been reported. Although particular nutrition education strategies have been studied in previous investigations, most of the studies related to younger children. Some methods were identified for nutrition education programs, including an integrative school curriculum approach, employing a wide range of teaching methods in schools, development of food skills, and game-based nutrition education programs.

This research aims to address this gap in nutrition education guidance. It reports on food experts' views on the best strategies to transfer important N&FS knowledge to adolescents during formal education, in Australia and in Iran. Ultimately, these suggestions could inform guides to assist food and nutrition educators, school curriculum developers, and relevant policymakers in improving N&FS education programs for secondary schools in Australia and Iran.

Chapter 3: Study methodology

3.1. Purpose of this research

This research has four key purposes:

- 1) to identify important nutrition and food systems (N&FS) issues that Australian and Iranian school-leavers need to know, from the perspectives of prominent food professionals
- 2) to investigate food professionals' views of Australian and Iranian school-leavers' current knowledge of N&FS
- 3) to identify the best strategies to improve Australian and Iranian school-leavers' knowledge of N&FS, from the perspectives of Australian and Iranian food professionals
- 4) to compare and contrast the views of Australian and Iranian food experts regarding N&FS knowledge and education.

The focus was on Australia and Iran as two case studies of a developed country and a developing country, respectively. Investigation of two very different countries in this study provided the opportunity to explore the extent to which professionals' concepts of required N&FS knowledge, and their recommended strategies to improve school-leavers' knowledge in this area, are constant across cultural and social differences.

3.2. Suitability of qualitative approach for this research

Qualitative research methods were adopted in this research project. Such methods were important, as the research questions were new; there was little pre-existing knowledge of the area upon which to base them (Faltermaier, 1997). Qualitative research aims to explore individuals' attitudes in their own natural settings without making personal judgements throughout the data collection (Bowling, 2014). This approach aligned with the four key purposes of this research.

Qualitative research is able to explore the meaning, behaviour and experiences of a purposefully selected sample (Kitto et al., 2008). Data in a qualitative study

are usually collected from observation, conversation or documentation (Kitto et al., 2008). This method of research typically involves systematic collection, classification, explanation and interpretation of word-based data (Kitto et al., 2008), though increasingly audio and visual data are also collected (Kitto et al., 2008). O'Leary stated:

... delving into qualitative methodologies means working in a world that accepts and even values: the search for holistic meaning; research conducted in natural settings; emergent methodological design; small numbers; non-random samplings; rich qualitative data; inductive analysis; and idiographic interpretation (O'Leary, 2010: 114).

Employing qualitative research methodology in nutrition fields is neither new nor rare (Neumark-Sztainer et al., 1999; Swift and Tischler, 2010; Pilnick and Swift, 2011). Qualitative research methodology has been used in numerous nutrition-related studies that are relevant to this research project, such as the investigation of school-based interventions (Dalma et al., 2015), identification of components of food literacy (Vidgen and Gallegos, 2014) and young adults' perceptions of food literacy (Ronto et al., 2016a).

3.3. Study design

This research employed semi-structured interviews with a range of prominent food professionals from Australia and Iran. The following sections in this chapter describe participant selection and sample size, strategy and process of data collection, and the process of data analysis.

3.3.1. Participants

This study recruited 20 prominent food professionals from Australia, and 20 from Iran via purposive sampling. The number of participants from each country was based on interviewing a sufficient number of participants to achieve data saturation. (Data saturation is described in section 3.3.2. Data collection).

In the literature, it is reported that there are no specific criteria or formulae to calculate appropriate sample size in qualitative research (Isaacs, 2014). It is reported that 12 to 26 participants might be enough to conduct qualitative research (Isaacs, 2014). In a recent study investigating sample size for qualitative research, Boddy (2016) expressed that sample size in qualitative research depends on the context and paradigm of the research and that in-depth, qualitative research does not usually require the recruitment of a large sample. Boddy (2016) stated that any sample size of more than 30 in-depth interviews or more than 12 focus groups for a single market or country could be considered large, and would require justification. Thus, this study's aim to recruit 20 participants from Australia and 20 from Iran was an appropriate starting point for data collection.

Purposive sampling was used to identify prominent food professionals in Australia and Iran (Harris et al., 2009). The aim was not to select a representative sample from a population (Pope and Mays, 1995) but to use a systematic, non-probability method to recruit a particular group of people with specific characteristics (Pope and Mays, 1995). This was consistent with Valero and colleagues' view, who stated that purposive sampling "aims to maintain rigor and identify a sampling frame based on specific study driven variables or characteristics" (Valerio et al., 2016: 3). The purpose of this research was to consider various N&FS aspects by selecting food professionals from various relevant fields. These fields included nutrition, dietetics, public health nutrition, home economics, food technology, agricultural sciences, veterinary science (including those with experience in farm animal welfare) and environmental science.

The selection of participants was drawn from two major groups in each country:

- 1) acknowledged academics from top ranking universities
- 2) highly experienced experts from governmental and non-governmental organisations.

Experts' contributions to N&FS education programs and food-related research were the determining factors for participant selection. To identify the most appropriate participants, web-based investigations of staff profiles of relevant schools or departments from top ranking Australian and Iranian universities were performed. Further information was obtained through ResearchGate and LinkedIn, to assess potential participants' contributions to N&FS issues (e.g. publications). Potential participants needed to be involved in food-related knowledge and/or education research, or otherwise active in child and adolescent food education programs. The aim was to recruit the majority of participants from those who occupied positions at the top of the career hierarchy within their organisations (e.g. heads of schools, chairs).

Recruitment included Australian professionals from five states (New South Wales, Queensland, Victoria, Western Australia and South Australia) and one territory (Australian Capital Territory); the Iranian experts were drawn from major provinces, including Tehran, Isfahan, Fars and Gilan.

Potential participants were invited via email, and follow-up phone calls were made. In cases where no response to the email was received, participants were contacted and invited via telephone. Invited professionals were asked to participate in either face-to-face or telephone interviews. The experts who agreed to participate were sent the consent form, participant information sheet and interview questions via email. Interview times, dates and places were arranged via email and/or follow-up phone calls. Before starting each interview, participants provided an informed written and/or recorded verbal consent. Ethics approval was obtained from the Human Research Ethics Committee at the University of Wollongong (ethics approval number: HE12/277).

Semi-structured face-to-face or telephone interviews were conducted to collect the required data. Data collection ceased when data saturation occurred. Saturation, for qualitative studies, is considered to assure that enough data has been collected for each of the investigated countries (Walker, 2012). Walker described saturation as the continuing process of the collection of qualitative data until redundancy of data takes place, and referred to two types of saturation:

- 1) theoretical saturation, which happens when no more new themes are generated from the dataset
- 2) data saturation, which happens when no new information is initiated from the dataset.

Researchers might aim to achieve one or both types of saturations (Walker, 2012).

3.3.2. Data collection

In this qualitative study, semi-structured face-to-face or telephone interviews were conducted to collect the required data. In order to collect qualitative data, several methods can be applied, including focus groups, interviews, observations, internal and external documents, photograph inspection and the Delphi technique (which may use various mediums, such as paper and pencil, in-person and internet) (Harris et al., 2009). A commonly used method of data collection in qualitative health research is interview. An “interview” can be defined as a purposeful conversation (Draper and Swift, 2011). This study used the interview technique, as interviews provided the opportunity to obtain detailed data from each member of the sample (Britten, 1995; Harris et al., 2009).

Interviews may be structured, semi-structured or unstructured (O'Leary, 2010). In structured interviews, pre-established questions are used in a prearranged order. Semi-structured interviews have a flexible structure and a question guide (open-ended questions). Unstructured interviews aim to produce an informative and rich conversation without prearranged questions (O'Leary, 2010). The semi-structured interviewing method, which was adopted in this study, assists the interviewer not only to collect the required data but also to obtain surprising, unexpected and interesting data that emerge during the interview (O'Leary, 2010). Semi-structured interviewing was particularly relevant as it has been identified as useful to investigate opinions (Longhurst, 2009) and provided a flexible structure that assisted the interviewer to start with a clear question plan and then follow the natural flow of the conversation (O'Leary, 2010).

Semi-structured interviews have been used in many nutrition-related studies to explore areas that had not yet been well researched (Orrevall et al., 2004; Giskes et al., 2005; Lemaire et al., 2011), as is the case for this study. For instance, semi-structured face-to-face interviews with 29 teenagers in Australia were conducted to investigate their health and nutrition beliefs (Giskes et al., 2005). In a study in Stockholm, semi-structured interviews were performed with 13 patients with advanced cancer, and 11 of their family members, to explore their experiences of the nutritional circumstances before the introduction of home parenteral nutrition (Orrevall et al., 2004). Also, semi-structured interviews with 20 physicians in Canada were performed to explore their views in relation to poor nutrition in the workplace (Lemaire et al., 2011). In brief, using semi-structured interviews to explore participants' views and beliefs regarding particular nutrition-related issues was a well-recognised technique among nutrition researchers.

In this research, open-ended questions were used for the semi-structured interviews with Australian and Iranian food professionals (O'Leary, 2010). Open-ended questions not only assist the interviewer by guiding the process of interviewing but also allow for new questions to be generated in response to the interviewees' explanations and comments (O'Leary, 2010).

3.3.2.1 The open-ended interview questions used in this research

The primary researcher, in consultation with her supervisors, designed 10 open-ended interview questions. These were reviewed by a panel of four acknowledged academics with strong food and nutrition backgrounds, from the University of Wollongong.

The interview questions employed to investigate the first three aims of this study are outlined below.

Aim 1: To identify important N&FS issues that Australian and Iranian school-leavers need to know, from the perspectives of prominent food professionals

The questions relating to this aim were:

- What do you consider the average school-leaver should broadly know about nutrition and food systems? (What do students need to learn before school-leaving age?)
- If we try to outline the most important issues to be included in the education curriculum, what do you think are most important? Why?
- What food-related skills do you think students need to develop?

Aim 2: To investigate food professionals' views of Australian and Iranian school-leavers' current knowledge of N&FS

The questions relating to this aim were:

- What aspects of nutrition and food systems knowledge do you think school-leavers are well informed about?
- Why do you think their knowledge is good in these areas?
- What aspects of nutrition and food system knowledge do you think school-leavers are not well informed about?
- Why do you think their knowledge is poor in these areas?

Aim 3: To identify the best strategies to improve Australian and Iranian school-leavers' knowledge of N&FS, from the perspectives of Australian and Iranian food professionals

The questions relating to this aim were:

- What are the best strategies to increase school-leavers' knowledge of nutrition and food systems?
- What do you think could be done differently to increase their knowledge?
- Do you have other suggestions for school-based nutrition and food systems education programs?

Aim 4: To compare and contrast the views of Australian and Iranian food experts regarding N&FS knowledge and education.

The fourth aim is to compare the results from the first three aims; no interview questions were necessary.

3.3.3. Data analysis

Two data analysis methods were used in this research, including inductive thematic analysis (Braun and Clarke, 2006; Vaismoradi et al., 2013) and Attride-Stirling's thematic networks framework (Attride-Stirling, 2001).

In qualitative analysis, the researcher needs to appropriately interpret and describe the data (Graue, 2015). The different approaches used to analyse qualitative data can be grouped into three categories:

- 1) Sociolinguistic methods, such as discourse and conversation analysis, exploring the use and meaning of language.
- 2) Methods, typified by grounded theory, that focuses on developing theory.
- 3) Methods, such as content and thematic analysis, that describe and interpret participants' views (Smith and Firth, 2011: 54).

In analysis of qualitative data, investigators must deal with concepts and meanings. It is necessary to classify the data carefully and develop a conceptual framework (Graue, 2015). Use of analytical frameworks to analyse interview data is advised (Smith and Firth, 2011). One commonly used analytical tool is Attride-Stirling's thematic networks framework (Attride-Stirling, 2001), which provides a step-by-step guide to the analysis of the interview data (described in section 3.3.3.2. Process of qualitative data analysis in current research). The other analysis approach used was inductive thematic analysis (Braun and Clarke, 2006; Vaismoradi et al., 2013), in which researchers do not code the data to fit into a pre-established coding frame or to fit into the investigators' analytic perceptions. This method of analysis is data driven (Braun and Clarke, 2006), which made it suitable for this study.

3.3.3.1. Process of data preparation for qualitative analysis in this research

All the interviews were audio-recorded, with participant permission, to facilitate accurate recording of the conversation. The Australian interviews were transcribed verbatim by a professional audio transcriber from the University of Wollongong, and reviewed and checked by the candidate. The transcripts were uploaded to NVivo (QSR NVivo 10) for analysis. The Iranian interviews were conducted in Farsi by the candidate (Farsi is her first language). The interviews were transcribed in Farsi and then translated into English for analysis. English translations of Iranian interviews were randomly checked and confirmed by the Iranian co-supervisor of this PhD research. English translations of these interview transcripts were uploaded to NVivo (QSR NVivo 10) for analysis. In addition, the interview transcripts were manually analysed to support the process of data analysis.

The dataset was firstly considered by country and then by the three categories aligning with the study aims. These six separate subsets of data and relevant peer-reviewed literature addressed experts views on the following six issues:

- N&FS issues that Australian school-leavers need to know about
- N&FS issues that Iranian school-leavers need to know about
- Australian school-leavers' current knowledge of N&FS and factors that influence school-leavers' N&FS knowledge
- Iranian school-leavers' current knowledge of N&FS and factors that influence school-leavers' N&FS knowledge
- recommended strategies to improve school-leavers' knowledge of N&FS, as proposed by prominent experts in Australia
- recommended strategies to improve school-leavers knowledge of N&FS, as proposed by prominent experts in Iran.

3.3.3.2. Process of qualitative data analysis in current research

The data analysis process used number of steps.

The first step of Attride-Stirling's thematic networks framework (Attride-Stirling, 2001) involved reading and re-reading the interview transcripts to become familiar with the data and to identify lowest order codes (basic themes). The dataset was then coded based on these basic themes, after several reviews of the interview manuscripts.

The second step was to identify the connected basic themes and group them together as middle-order themes (organising themes). Then the basic themes were reviewed and organising themes were arranged and labelled, in consultation with the primary supervisor.

The third step involved the generation of global themes. At this stage, the main claims or the higher order themes were formed by appropriately grouping the organising themes. Finally, the transcripts were reviewed several times to check the thoroughness of the generated organising and global themes. Final agreement was reached among the investigators in relation to the levels of themes, and labels for the organising and global themes (Attride-Stirling, 2001).

The other analysis approach used was inductive thematic analysis (Braun and Clarke, 2006; Vaismoradi et al., 2013). To conduct inductive thematic analysis, the first investigator read and reviewed all the transcripts several times to become familiar with the data. Initial codes were generated from key features of the entire dataset. Potential themes were generated from coded data by the first investigator and were reviewed, re-reviewed and named by the first and second investigators. The reviews of transcripts continued until no new themes emerged from the dataset. Afterward, themes were labelled for the final report. Lastly, a brief report of identified themes and details of each theme and sample were developed to present the findings in a clear strategic manner (Braun and Clarke, 2006; Vaismoradi et al., 2013).

3.4 A scholarly guide for assessment of the current qualitative research

A guide for assessment of qualitative research, developed by Kitto and colleagues (Kitto et al., 2008), was used to ensure rigour in this study. The components of this guide are outlined Table 3.1.

Table 3.1 Assessment of this qualitative research

<p>Clarification What is the aim of this research? What are the research questions?</p>	<p>This study aims to identify the most important N&FS issues for school curricula, current gaps in school-leavers' knowledge of N&FS, and best strategies to improve school-leavers' knowledge of N&FS. Ten research questions were used to collect the required data, via the interviewing method. (See section 3.3.2. Data collection).</p>
<p>Justification Why is a qualitative method the best option to answer these research questions?</p>	<p>Qualitative research tries to comprehend individuals' attitudes without making personal judgements (Bowling, 2009). This study also explored food experts' views regarding different N&FS knowledge issues. Reasons for the selection of a qualitative methodology are given in section 3.2. Suitability of qualitative approach for this research.</p>
<p>Procedural rigor</p>	<p>The procedures of recruiting participants, data collection and data analysis are clearly explained in section 3.3. Study design and are also briefly mentioned in the method sections of all produced peer-reviewed papers. All employed methods for sampling, data collection and data analysis are supported by peer-reviewed literature to assure the procedural rigour of the current research.</p>
<p>Interpretation</p>	<p>Seven peer-reviewed papers and one letter to the editor were developed to clearly present the findings of this research project in a strategic manner. All findings are compared with relevant Australian, Iranian and international scholarly studies.</p>

<p>Reflexivity and evaluative rigour (ethics approval & ethical issues)</p>	<p>Ethics approval was obtained from the Human Research Ethics Committee at the University of Wollongong (approval no. HE12/277). Participants were de-identified using numbers to preserve anonymity. All participants of this study were food professionals who were familiar with research procedures. Written and/or recorded verbal consents were obtained prior to the interviews. The participants reported no ethical issues or concerns.</p>
<p>Transferability Has a critical evaluation of the application of findings to other similar contexts been made?</p>	<p>The relevance of the findings have been compared and discussed in relation to not only other Australian and Iranian studies but also literature and education guides from across the world. To our knowledge, to date there has not been such a holistic study focusing on improving school-leavers' knowledge of N&FS that also incorporates educational guides to improve school-leavers' knowledge of N&FS. The findings from this research have been cited both nationally and internationally. In addition, due to the similarities regarding the components of the guides developed for Australia and Iran, there is potential for transferability for other developed and developing countries. At a minimum, these findings could support overseas curriculum and policy developers in the development of their own guides.</p>

3.5. Conclusion

The method of this research was in-depth, semi-structured interviews undertaken with a wide range of food professionals in Australia and Iran. The experts were purposefully selected to explore their views regarding N&FS knowledge issues. Qualitative data were analysed using the inductive thematic analysis approach and Attride-Stirling's thematic networks framework. Using a qualitative research methodology resulted in the attainment of rich, informative, qualitative data. The findings obtained from this study were intended to assist curriculum and policy developers and food educators in Australia and Iran to improve school-leavers' knowledge of N&FS. In addition, conducting the investigation in two very different countries provided the opportunity to explore the extent to which these professional concepts of required N&FS knowledge, and their recommended strategies to improve the school-leavers' knowledge, were constant across cultural and social differences.

Chapter 4: Australian study, part 1

This chapter presents the first part of the Australian study. It answers the following research questions:

- 1) What are the important nutrition and food systems (N&FS) knowledge issues for Australian school-leavers? Why?
- 2) Of the important N&FS education programs for high school students identified, which ones would you consider to be the most important? Why?

Australian food professionals' views of important N&FS knowledge issues for Australian school-leavers were collected and analysed. This qualitative investigation was performed by conducting semi-structured interviews with 21 prominent food professionals in Australia. The study identified essential N&FS components for secondary school curricula in Australia. These findings led to the development of a scholarly guide for N&FS education programs for Australian adolescents.

This chapter was published in the peer-reviewed journal *Nutrients* (see Appendix 1) in the course of this PhD degree. It is presented here with minimal modifications to formatting, related to referencing style and page layout, to create a cohesive document and to follow the University of Wollongong's recommended referencing style.

Citation: Sadegholvad S, Yeatman H, Parrish AM, et al. (2017) What should be taught in secondary schools' nutrition and food systems education? Views from prominent food-related professionals in Australia. *Nutrients* 9(11): 1–14.

Authors' contribution: This study was designed by Sanaz Sadegholvad, Heather Yeatman, Anne-Maree Parrish and Anthony Worsley. All interviews were conducted by Sanaz Sadegholvad. Sanaz Sadegholvad collected and analysed the data, and Heather Yeatman supervised different stages of the data collection and data analysis. Sanaz Sadegholvad developed the first manuscript, and the other authors reviewed and improved the manuscript.

4.1. Abstract

Education can help young people to attain the knowledge and skills they need to make proper food choices and develop lifelong healthy eating patterns. This study explored the perspectives of prominent food-related professionals in Australia regarding essential nutrition and food systems (N&FS) education programs for adolescents during formal education. Semi-structured interviews were conducted with 21 prominent food-related professionals in Australia. Interview transcripts were analysed thematically. Four essential areas for N&FS education programs were identified. 1) Key nutrition messages to a healthy lifestyle; 2) Skill development programs to enhance health and wellbeing; 3) Ethical food-related lessons to support environmental sustainability, farm animal welfare, local producers, and food security; and, 4) Introductory lessons about foods from farm to plate to facilitate more informed food choices. Findings of this study may provide new insights for curriculum developers in Australia for further assessment of current gaps in N&FS components of secondary school curriculum. Integration of these four areas into secondary school curricula has the potential to enhance adolescents' knowledge of important scientific and ethical issues in a range of N&FS fields, and enable them to develop fundamental food-related life skills supportive of health and wellbeing.

Key words: nutrition; food systems; education; secondary schools; and adolescents.

4.2. Introduction

Globally, unhealthy dietary patterns and sedentary behaviours are known as leading risk factors for health and wellbeing. Rapid urbanisation, changing lifestyles and increased production and ready availability of highly processed foods have shifted people's dietary patterns. This dietary pattern has increased the consumption of fats, energy-dense foods, and for many people, the inadequate consumption of vegetables, fruits and whole grains (World Health Organization [WHO], 2015). The Australian population does not consume recommended amounts of different food groups (Australian Bureau of statistics

(ABS), 2016). Less than four percent consume the recommended amounts of vegetables, legumes and beans; only 30% meet the recommendation for fruits; around 30% meet the recommendation for grain; and approximately 35% of the total daily energy intake of Australians comes from discretionary foods like sugar sweetened beverages, cakes and confectionery (ABS, 2016).

Dietary behaviours during adolescence contribute to the establishment of lifelong eating patterns (Ambrosini et al., 2009). Unfortunately, the dietary behaviours of a large proportion of Australian adolescents deviate from the national dietary recommendations, (Savige et al., 2007) and increase their risks of nutrition-related health problems like obesity and insulin resistance (Savige et al., 2007).

Healthy eating habit among adolescents and children are essential for healthy growth, cognitive development and other aspects of health and wellbeing (Van Cauwenberghe et al., 2010). In addition, adaption of healthy eating habit has been linked to reduced risk of chronic diseases in their future life (Van Cauwenberghe et al., 2010).

As Story et al. note:

Nutrition education can help young people attain the knowledge and skills they need to make healthful food choices and develop lifelong healthy eating patterns. Schools are ideal settings for nutrition education because they reach most youth, and nutrition fits into several subject areas including health, science, and consumer science (Story et al., 2002: 121).

School-based nutrition education curricula should aim to improve students' knowledge, skills, self-efficacy and behaviour aligned with the dietary guidelines (Perez-Rodrigo and Aranceta, 2003). However, schools in many western (Perez-Rodrigo and Aranceta, 2003; Carraway-Stage et al., 2015; Stephens et al., 2016) and non-western countries (Kazemian et al., 2014) have not used their potential to deliver food-related education programs. A review study of adolescents' food literacy programs (Brooks and Begley, 2014) identified lack of effective programs

for adolescents, and uncovered the greater focus of current programs to educate younger adolescents rather than older adolescents (Brooks and Begley, 2014).

Globally, the major focus of current school-based education programs has been on promoting healthy dietary behaviours (Pollard et al., 2008; Ritchie et al., 2015; Tavassoli et al., 2015a; Zhou et al., 2016), and Australian investigators have also shown a similar trend in their studies (Pollard et al., 2008; Fordyce-Voorham, 2011; Gibbs et al., 2013). However, some nutrition researchers have argued that nutrition education programs should not be limited to health-related aspects of food consumption (Harmon and Maretzki, 2006a; Lawrence and Worsley, 2007a; Parrish et al., 2016; Sadegholvad et al., 2016; Vidgen, 2016; Sadegholvad et al., 2017a). These educators highlighted the need to educate students (Harmon and Maretzki, 2006b; Harmon and Maretzki, 2006b; Sadegholvad et al., 2016; Sadegholvad et al., 2017a) or more broadly consumers about food systems-related issues (Parrish et al., 2016; Vidgen, 2016; Sadegholvad et al., 2017e), covering production, processing, packaging, distribution, retailing, consumption and wastage of food (Worsley et al., 2015b). A major reason for this emphasis on the different aspects of food systems is to promote informed food choices that aim to sustain and protect the environment.

It is well-established that food production and consumption impact the environmental sustainability (Harmon and Maretzki, 2006b; Public Health Association of Australia [PHAA], 2015a; Worsley et al., 2015b; Worsley et al., 2015a; Vidgen, 2016; Sadegholvad et al., 2017a; Sadegholvad et al., 2017e). For example, current agricultural practices are contributing to greenhouse gas emissions, excess water use and land degradation (The Food and Agriculture Organization of The United Nations [FAO], 2006; Koneswaran and Nierenberg, 2008; Worsley et al., 2015a). Consequently, the dietary patterns and food choices that are more supportive of environmental sustainability are recommended (PHAA Australia, 2015a; Worsley et al., 2015a). Australians' current eating patterns pose risks to both environmental sustainability and people's health (Worsley et al., 2015a). For example, in a very recent literature the problem of excess energy intake in western diets, including Australia is reported. In this

literature it is highlighted that discretionary foods not only contribute to increased energy intake while lack the nutrients, but also “inflate environmental burdens of diets” (Ridoutt et al., 2017)

Western and non-western studies have reported the importance of food systems knowledge and relevant education programs to make more informed food choices (Harmon and Maretzki, 2006b; Parrish et al., 2016; Sadegholvad et al., 2017a). However, previous research have not shown significant attention toward school-based food systems education programs. The majority of nutrition education programs within school setting mainly aim to promote health-related aspects of dietary behaviours (e.g. (Shi-Chang et al., 2004; Christian et al., 2014; Stage et al., 2016)).

The importance of N&FS education has been highlighted by several studies as a mechanism to improve adolescents’ capacities to make more informed food choices (Harmon and Maretzki, 2006a; Harmon and Maretzki, 2006b; Sadegholvad et al., 2016; Sadegholvad et al., 2017a). Education about specific areas of the N&FS have been highlighted in the literature. For example, education on food groups and dietary guidelines to support adolescents in their selection of healthier food options and healthy eating patterns (Sadegholvad et al., 2017a). Awareness of the association between foods and the environment to promote food choices that are more supportive of environmental sustainability (Harmon and Maretzki, 2006d). Education about the welfare of farm animals has been raised in literature to promote selection of animal-welfare friendly food products (Sadegholvad et al., 2016). In addition, the importance of informing adolescents about the consequences of their food choices on local farmers has been highlighted (Harmon and Maretzki, 2006a).

Australian adolescent’s knowledge of some aspects of N&FS was explored in a recent study among 131 secondary school students aged 12-17 (Ronto et al., 2016a). The study results showed participants’ very limited knowledge about food ethics (environmental sustainability and animal welfare) (Ronto et al., 2016a). Findings of this study also revealed participants’ lack of understanding of information on food packages, which negatively affected adolescents’

willingness to read food labels (Ronto et al., 2016a). These findings are consistent with another study related to the Australia that explored Australian food professionals' views of Australian adolescents' knowledge of N&FS (Sadegholvad et al., 2017e). Food professionals in Sadegholvad and colleagues' study perceived that Australian adolescents, have insufficient knowledge of N&FS issues and knowledge shortage was particularly highlighted in relation to food production processes in conjunction with food ethics (Sadegholvad et al., 2017e).

In the current curriculum for the secondary schools in Australia, there are two key areas where food and nutrition topics are covered, to some extent including "Health and Physical Education" and "Design and Technologies" (Australian Curriculum Food and Wellbeing, 2017). However, it is unlikely that different components on N&FS such as those relating to the connections among people's food choices, food production and food ethics (e.g. environmental sustainability) are well addressed. In addition, it is not known what, if any, research informed of the development of these curriculum areas. Also the actual average hours currently allocated for N&FS education in different years in secondary schools across the Australia is not known. The qualitative study reported here aimed to focus on one part of the current gaps in literature related to the appropriate N&FS curriculum for secondary schools in Australia. This study addressed the perspectives of the prominent food-related professionals in Australia about essential N&FS components for secondary schools.

4.3. Materials and methods

A group of prominent food-related professionals were recruited who had expertise in particular area(s) of nutrition and food systems (N&FS). The participants included nutritionists, dietitians, public health nutritionists, home economists, environmental scientists, agricultural scientists and veterinary scientists (experts in animal welfare and farm animal production systems). Purposive sampling was used to select highly experienced professionals from each food-related discipline (Coyne, 1997). The participants included: academics in top ranked universities of Australia; professionals who held key roles in well-

recognised government and non-government organisations; as well as senior community nutrition educators/promoters in Australia. For this purpose a thorough investigation of the websites of all relevant schools or departments related to major universities across Australia was performed. The profiles of academic staff were explored to identify the potential academic participants. A thorough web-based investigation of relevant government and non-government organisations in Australia was undertaken to select a group of non-academic professionals. A final list of forty potential participants was developed and confirmed by all the authors of this study.

Ethics approval was provided from the Human Research Ethics Committee (Health and Medical) of the University of Wollongong (approval no: HE12/277). Potential participants were invited via email. The professionals who accepted the invitation, received electronic versions of the information sheet, interview questions and consent form, one to two week(s) before each interview. Dates, times and locations for all interviews were arranged via email.

All of the participants provided recorded verbal and/or written consent before and/or at the beginning of their interviews. Semi-structured face-to face (n=7) or telephone- based (n=14) interviews were conducted between August 2012 and March 2014 to explore the professionals' views of the essential components of education programs for secondary school students. The extended period of data collection reflected limited availabilities.

Very broad interview questions were used to minimise leading the conversations and to provide the opportunity for participants to refer to those parts of nutrition and food systems that were related to their area(s) of proficiency. Interview questions were designed by the authors of this study and were confirmed by four experienced nutrition-related academics at the University of Wollongong, who were experienced in conducting qualitative research.

Prior to this study, the interview questions were used in a similar study for interviewing 28 food-related professionals in Iran (Sadegholvad et al., 2017a).

Two key open-ended questions and relevant prompts (if necessary) were used in all interviews. The key questions were:

- 1) What are the important nutrition and food systems (N&FS) knowledge issues for Australian school-leavers? Why?
- 2) Of the important N&FS education programs for high school students identified, which ones would you consider to be the most important? Why?

The participants were asked to focus on those areas of N&FS that were directly linked to their area(s) of expertise.

Simultaneous data collection and data analysis were performed to continue the interviews until saturation occurred (Bowen, 2008). Thematic saturation occurred after interviewing twenty-one participants (Bowen, 2008). The interviewed professionals included: four dietitians, four home economists, four nutritionists, three public health nutritionists, one public health expert, two food scientists, one environmental scientist and two experts in animal welfare and animal-sourced food production systems.

Audio-recorded interviews were transcribed verbatim by a professional audio transcriber and crosschecked by the first author. Interview transcripts were analysed thematically (Braun and Clarke, 2006) using NVivo 10, a qualitative data analysis package. Inductive thematic analysis was used resulting in the identified themes being strongly linked to the data themselves (Patton, 1990; Braun and Clarke, 2006). The data set was coded without using any pre-existing coding frame or analytic preconceptions, and the process of data analysis was completely data driven (Braun and Clarke, 2006). The analysis method undertaken included: reading and re-reading the interview transcripts; generating initial codes; identifying potential themes; reviewing themes; defining and naming themes; and developing report (Braun and Clarke, 2006). In addition to the first analysis of the dataset, a second manual analysis of all interview transcripts was performed to identify any potential new theme missed over the first analysis. Minor changes occurred after the second analysis. Identified

themes were reviewed and areas of N&FS education were developed, named and confirmed.

4.4. Results

The essential components for nutrition and food systems (N&FS) education programs for secondary school students identified by the participants were grouped into four areas. These areas were: 1) Key nutrition to support a healthy lifestyle; 2) skill development to enhance health and wellbeing; 3) ethical food-related components to support environmental sustainability, farm animal welfare, local producers, and food security; and 4) introductory components about foods from farm to plate to make more informed food choices. Each of these areas is described separately below.

4.4.1. Key nutrition messages to support a healthy lifestyle

The majority of the participants across the different groups of professionals referred to the basic recommendations of national policy guides as one of the most important components for school-based education programs. The aim was to develop a “basic understanding” of healthy dietary recommendations among students. They believed that the “core food groups” should be introduced as the “building blocks” of nutrition education for the formal education system in Australia.

Some of the participants highlighted that the focus needed to be on “basic” and “simple” messages. They explained that it was not necessary for adolescents to know the details of current dietary guidelines, but it was necessary for them to know “what are the core food groups”, “roughly how much they need to eat to meet their health requirements” and “the equivalents” in each group. In this area some participants reported that adolescents need to know that they should consume “plenty” of vegetables and legumes, “balanced” amounts of cereals and fruits, “smaller” amounts of animal-based products and “a little” amounts of healthy oils on a daily basis. They also reported the need to raise students’

awareness of the relationships between each food group and people's health to encourage them "to consume a variety of all core food groups in balance".

I think they should have at least basic knowledge of food groups and what the major nutrients sources are. So I don't think they need to even understand completely why they need all different foods but at least have some concept of variety and, and what might be important in variety and, and probably an understanding of the core food groups so food groups that they actually may get nutrition from as opposed to a lot of the other things that they might be eating. (Dietitian)

Two of the dietitians and one of the public health nutritionists underscored the important role of a "positive push" in nutrition education programs for children and adolescents. They considered that nutrition-related messages need to shift toward more positive and encouraging messages rather than negative and prohibiting ones.

I think there needs to be a real positive push towards nutrition and health so that, not just always focusing on the negative that fats are bad, and too much energy is bad, and too many soft drinks are bad, often that's the message kids get rather than you know what does a healthy nutritious diet look like and, and why is it important to be able to understand that. (Public health nutritionist)

Some of the public health nutritionists, dietitians, nutritionists and home economists also identified three other nutrition education issues for secondary school students. One was related to the importance of maintaining healthy weight through appropriate diet and physical activity without developing a negative body image. The second issue related to nutrition requirements during pregnancy, as there was the potential for adolescent pregnancy. The last highlighted issue was related to providing encouraging messages about the importance of breastfeeding to create a 'positive attitude' among Australian adolescents about this issue. Nutrition education in relation to pregnancy and breastfeeding were recommended for students who were studying in the last two years of secondary school.

The average school-leaver needs to understand the needs to support a healthy pregnancy ... They should consider the whole issue of breastfeeding. ... most boys and girls have established their attitude toward breastfeeding by the time of 15 and 16. So young age group needs to be given some facts and information about the value and place of breastfeeding. (Nutritionist)

Other participants commented on the importance of avoiding unnecessary information, using the example of nutrition for early parenthood. They believed it was more appropriate to provide this kind of information at more relevant stages of life (e.g. “when a person becomes pregnant”).

4.4.2. Skills development programs to enhance health and wellbeing

Most of the participants, including home economists, public health nutritionists, dietitians, nutritionists and the public health expert, underscored the need for adolescents to build and develop a range of essential food-related, life skills, supportive of healthy dietary practices in the secondary school. For example, it was noted that students needed to develop enough skills and confidence to enable them to take action for “what are we going to have for dinner tonight?” One of the dietitians expressed the view that the “old home economics education type model” is more useful for everyday life compared to the “academic-based model of nutrition education” (implying a more science-based and theoretical approach).

These professionals identified a range of necessary skills from food “planning” and “selection”, to “safe food storage”, and also the skills to grow vegetables. In some cases participants from the different groups of professionals gave specific attention to particular skill(s) (as mentioned in following paragraphs).

Most of the participants mentioned the need to enhance students’ understanding of food labels to make more informed food choices. Some of them also mentioned the need for developing skills to “critically interpret” food labels to avoid being manipulated by the food industry. The public health expert noted that building

food label interpretation skills among adolescents and other population groups “pushes the food industry to improve different aspects of their products”.

They [students] need to understand food labelling and what marketing and branding is to make healthy food choices. They need to be educated in how to guide their way through food packages, labels and supermarket choices, so to be able to compare some of the kinds of food for the best option. (Public health nutritionist)

Most of the home economists, public health nutritionists and nutritionists reported the need to offer budget management education to secondary school students to enable them to select, shop and prepare affordable and healthy foods. Some of these professionals referred to a common view among some people in Australia that “it is expensive to eat healthy foods” and that this needed to be corrected. The budget management lessons they recommended should include “the best value seasonal ingredients”; “learn to freeze particular foods when they are cheap”; and learn to select affordable alternatives (e.g. “canned lentils and beans as a cheap alternative to meat”).

They need to learn to utilise those convenience foods judiciously not relying totally on frozen foods and canned foods but incorporate them because they often are nutritionally equivalent to fresh foods. For example, buying dried chick peas and soaking them overnight, a canned – alternative can be just as cheap, you can usually buy a can of chick peas or lentils for a dollar, so every now and again, you know if you had those sort of staples in your pantry that’s a really good thing to have on hand. (Home economist)

In contrast, one of the nutritionists thought that budget management education was unnecessary. She expressed:

I think that kind of stuff is boring and I, I think it will turn students off if that’s how you want to present food and nutrition is about budgeting on a, on a low budget. (Nutritionist)

Other essential skill-development programs for students were reported, including: food preparation and cooking skills to provide “healthy”, “affordable”, “quick”, “simple”, “tasty” and “attractive” meals; and, food safety skills to “prepare” and “keep foods safely”. In this study, food preparation and cooking skills (consistent with the Australian dietary guidelines); and skills to prepare and store foods safely were mentioned most frequently as the food skills that should be included in school education programs. Some of the interviewees explained that if students are equipped with important textbook-based nutrition knowledge issues without building their food preparation skills, it will not be very useful for their everyday lives. For example, one of the dietitians mentioned that if students know that oily fish contains healthy oil and protein, but if they don’t know how to prepare it in a tasty and healthy way, then it is not enough to encourage them to consume it on a regular basis.

Preparation and presentation of foods for good health and satisfaction to support good and enjoyable eating experiences should be part of school-based education. ... Food safety skills go hand-in-hand with cooking skills.
(Home economist)

Lastly, the home economists noted that cooking courses conducted by qualified teachers, have the potential to train students about a range of other essential food knowledge issues and relevant skills, such as: food costs; affordable ingredients; recipe reading; principles of safe food preparation; nutrient composition of meals; the importance of key nutrients for adolescents’ health; basic way to combine foods from the core food groups in a meal, and healthy replacements in each food group.

Seven participants from groups of public health nutritionists, nutritionists, home economists and a dietitian reported that it was important for schools to provide students with opportunities to develop skills for growing plant-based foods (in schools or any other available settings arranged by schools). Some participants also suggested that students should visit farms to become familiar with growing techniques. School-based gardening activities would encourage students to consume more plant-based products, increase familiarity with “farming

practices” and also inform students to consider gardening skills as a budget management strategy. However overall, growing foods was less frequently mentioned compared to the other skills identified by the participants.

I think children learn by experience so it would be useful for them to have practical experience in terms of food growing. It can be useful for families with limited resources. Students can grow certain vegetables at school, or visiting farms to understand a little bit about farming practices. I think children just don't get enough exposure to that particularly kids in the city. (Public health nutritionist)

Table 4.1 Summary of the ethical issues raised by the participants

Key Food-Related Ethical Issue for Secondary School Curriculum	Example of Quotes
Simple animal welfare messages about the treatment of animals in food production systems	<p>“School-leavers need to know about animal welfare aspect of food production. The way, which they are born, reared, handled, transported and killed for food. In terms of intensive food production like laid hens for eggs and meat, or pigs for meat they are done indoor”</p> <p>— Animal welfare expert</p>
Globalization of the food supply and its impacts on the economy and the environment	<p>“...the way that food is distributed, imported and exported. Impacts on the local businesses, local farmers. The role of industry and jobs and people that are involved and affected. A broad understanding in the community of the food system”</p> <p>— Public health expert</p> <p>“For instance the fashion to produce super foods likes chia and quinoa. The consequences of that in terms of economic costs, social costs both in the places of production and in the local communities”</p> <p>— Public health nutritionist</p>
The environmental cost of global food transportation	<p>“They need to know about the environmental cost of transport, like climate change. ...I don’t think the education system either provides them with enough input”</p> <p>— Environmental scientists</p>
The importance of supporting local farmers and small local businesses	<p>“They need to know if they don’t buy Australian made and choose food, which is coming from overseas what implications that has then for the farmers in Australia...”</p> <p>— Dietitian</p>
Sustainable agriculture vs. intensive agriculture	<p>“I would like them to leave the school with some appreciation of sustainable agriculture not in great depth, but to know something about it”</p> <p>— Nutritionist</p>
The effects of food wastage and food packaging on the environment	<p>“Sharing the planet and having a responsible attitude towards food issues for example in terms of food wastage...also in relation to the environmental costs of over production...”</p> <p>— Public health nutritionist</p>
Food security on global and community levels	<p>“They need to understand food security on a global level and bringing it right down to a community level in terms of sort of the most vulnerable people in certain communities such as homeless, unemployed and those kinds of high risk groups. Some schools encourage children to do community service and that’s a good experience for them, perhaps if they can go to a soup kitchen or to volunteer. I think all school children should volunteer to deliver meals on wheels to older people because then it develops a healthy respect across the generation”</p> <p>— Public health nutritionist</p>

4.4.3. Ethical food-related lessons to support environmental sustainability, farm animal welfare, local producers and food security

Twelve participants (more than half of the participants) from across different groups underscored the need to educate secondary school students about value-based ethical issues that are associated with food production and consumption. They recommended inclusion of ethics lessons that aimed to promote more informed food choices among young Australians to protect the environment, and farm animal welfare and local farmers, and to reduce food insecurity.

A summary of the ethical issues raised by the interviewees is presented in Table 4.1. All the key food-related ethical issues presented in Table 4.1 have the same level of importance. In fact, the participant did not present a hierarchy of the most important ethical food related issues for adolescents.

The professionals, who raised these ethical issues noted that the purpose of school education is not to train environmental scientists or experts in the globalisation of food systems. The messages needed to be informative and simple but also limited. The importance of raising students' basic awareness of ethical food-related issues was that it supports informed food choices among Australians.

4.4.4. Introductory lessons about foods from farm to plate to make more informed food choices

Most of the participants frequently reported that secondary school curricula needed to cover issues like: "where do foods come from?", "how food is produced", "what makes up a food product" and "which foods are manufactured". Almost all of the interviewees reported that it was not appropriate at the secondary school-level to go into full details about foods journey from farm to plate. They made comments such as: "we have to be careful about the amount of details"; "really the basic stuff that kids don't know is enough"; and "knowledge has to continue to building after people leave school". A key purpose of secondary

food curricula should be to enhance students' basic understanding of current food production systems particularly in Australia and how the food production systems can affect human health. In addition, some of the professionals commented that raising high school students' knowledge of current food production systems would enable students to develop a better understanding of the ethical issues linked to food production systems.

If they eat bread then they need to know that that came from wheat and was made into flour and that was further processed and you know how it got to them. (Dietitian)

4.5. Discussion

The findings reflected the perspectives of prominent food-related professionals in Australia regarding essential areas of nutrition and food systems (N&FS) for school-based education programs for Australian adolescents. Four essential areas emerged from the interview transcripts that reflected the broad role that food plays in young people's lives and the breadth of knowledge and skills required: (1) Key nutrition messages to support a healthy lifestyle; (2) Skill development programs; (3) Food Ethics education; and, (4) Foods from farm to plate. Although the first and second areas are explored in previous studies (Fordyce-Voorham, 2011a; Brooks and Begley, 2014; Ronto et al., 2016a), this investigation added new findings that are related to these two areas to be considered for secondary school education programs. Few studies have focused on the third and fourth areas of knowledge (Food Ethics education and Foods from farm to plate) for school-based food education programs.(Sadegholvad et al., 2017a). One reason for this gap is the primary focus of the majority of the previous reported studies on educating students about nutrition for better health outcomes (Sadegholvad et al., 2017a). The current study revealed that professionals held a more holistic view on N&FS education for secondary school students when compared to previous studies (Parrish et al., 2016; Sadegholvad et al., 2017a).

This study identified all these four areas as essential for secondary school education programs. However, the majority of previous studies have shown significantly stronger attention Key nutrition messages to support a healthy lifestyle and Food skills for better health outcomes among adolescents (Fordyce-Voorham, 2011; Brooks and Begley, 2014) as compared to the Food Ethics and Foods' journey from farm to plate. Portraying these important areas together may provide new insights for curriculum developers in Australia to further assess the current gaps in secondary school curriculum.

The first identified area, "Key nutrition messages to support a healthy lifestyle", mainly referred to the basic recommendations in the dietary guidelines, particularly in relation to the food group, is supported by previous literature (Kristal et al., 1997; Beech et al., 1999; Aranceta et al., 2003). However, the importance of educating senior high school students about nutrition requirements during pregnancy, identified in current study, has not been well addressed previously. The major focus of previous studies has been on nutrition education at the time or during the period of pregnancy (Girard and Olude, 2012; Arrish et al., 2014), and not on preparation for pregnancy in the longer term. Recent Australian literature has identified the poor knowledge of pregnant women about important dietary recommendations (Bookari et al., 2016). The education of senior high-school students about the key nutrition requirements of pregnancy might positively impact the health status of young mums and their fetuses.

Continuing the theme of preparing for independent adult lives, the participants highlighted the need to create positive attitudes towards breastfeeding among senior secondary students. A study of women's reasons for ceasing breast feeding (Ahluwalia et al., 2005) revealed that women who had the intention to breastfeed before delivery were more likely to initiate and continue breastfeeding when compared to those who did not plan or those who were unsure whether to breast feed (Ahluwalia et al., 2005). The fostering of positive attitudes towards breastfeeding during adolescence might increase women's intention to breast feed and men's support for women who breast feed. Future school-based

nutrition education programs targeting senior high-school students might consider this issue further.

The second identified area was the importance of development of food-related skills to enhance healthy dietary behaviours, which is aligned with previous studies (Fordyce-Voorham, 2011a; Ronto et al., 2016a). The participants of the current study presented a broad reflection of essential food skills, such as critical or analytic approach to shopping, or informed participation in the food marketplace and its link to the interpreting of food label information to identify healthy food options. The participants also reported the application of this critical approach in the interpretation of food labels for ethical considerations as related to food production and procurement. Complementing this analytic approach was the identified need for practical skills, such as budgeting, growing food, and cooking, as supported by other studies (Fordyce-Voorham, 2011; Parrish et al., 2016; Sadegholvad et al., 2017a). Particular skills were identified as important, as well as the associated considerations around that skill, for example food preparation requires consideration of the food components, food safety, and nutrient content, which facilitate the process of communicating various important food topics with students and shows the efficacy of recommendations for everyday practices.

Notably, most of the participants in the present study placed stronger emphasis on food preparation, cooking, and food safety practices when compared to other food skills. A similar finding was reported by Ronto et al. (Ronto et al., 2016b) in their study of home economics teachers' views of food literacy. In addition, a recent review found a similar emphasis on food preparation skills (Brooks and Begley, 2014). In contrast to the review finding that most programs were directed towards younger adolescents, the present participants considered that these skills were necessary for all secondary school students with no preference toward younger adolescents.

The third identified area referred to the food ethics education. The current study provided a broad picture of important food-related ethical issues for secondary school education programs to support informed food choices among young

Australian. There are very limited number of studies that referenced to the importance of ethic-based food related education within the school setting, such as those relating to animal welfare (Ronto et al., 2016a), environmental sustainability (Harmon and Maretzki, 2006b; Ronto et al., 2016a), and the supporting of local farmers (Harmon and Maretzki, 2006b; Joshi et al., 2008). In fact, the majority of investigations related to school-based education programs have greater focus on improving students' health outcomes (Sadegholvad et al., 2017a). However, studies underlined the importance of increased consumer awareness of animal welfare to encourage the purchasing of animal welfare friendly food products (María, 2006; Taylor and Signal, 2009; Toma et al., 2012) and increased awareness of food and environmental sustainability to promote the transition toward ecologically sustainable diets (Public Health Association of Australia, 2015a; Worsley et al., 2015b).

A recent study of adolescents' food literacy in Australia showed that they have very limited knowledge of animal welfare and environmental sustainability issues (Ronto et al., 2016a). However, another Australian study of 2204 adults showed that they were concerned about a variety of animal welfare and food-related environmental issues (Worsley et al., 2015b). In contrast to our findings and to these two studies, a study related to Australia rated animal welfare and environmental sustainability as among the least important aspects of food literacy for secondary students from the perspectives of home economics teachers (Ronto et al., 2016b). This might be linked to the nature of participants' professions and the depths of their knowledge of these issues.

The last essential area identified in the present study concerned the journey of foods from farm to plate. Previous studies had considerably less focus on the exploration of school-based education programs that are related to food production systems and their impacts on health, environment, local farmers, and other issues when compared the first and second areas identified in this study. This might be due to the dominant focus of schools and nutrition researchers on the health-related aspect of nutrition for better health outcomes in children and adolescents (Sadegholvad et al., 2016; Sadegholvad et al., 2017a). However,

literature have documented the strong links between food production systems and human health (Røssvoll et al., 2013; PHAA, 2015a); food production sectors and environmental sustainability (The FAO, 2006; Worsley et al., 2014); and, food production sectors and animal welfare (María, 2006; Toma et al., 2012). Correspondingly, the need to increase students' awareness of these issues is reported in literature (Sadegholvad et al., 2017a).

Overall, this study explored what experts considered to be essential knowledge areas that would facilitate informed food choice behaviours of young adults. A wide range of topics for food education programs of adolescents was identified as necessary, many of which were consistent with previous reported areas (Fordyce-Voorham, 2011; Ronto et al., 2016a; Ronto et al., 2016b; Sadegholvad et al., 2017a; Sadegholvad et al., 2017e). This study also identified other areas that are considered to be important for adolescents' education programs that have been less reported in previous studies, for example, educating senior adolescents about nutrition requirements during pregnancy and the importance of creating positive attitude about breastfeeding. Other less explored areas identified were the non-health aspects of food systems education, including food production and a broad approach to food ethics.

These findings also might be helpful for other countries. A similar study conducted by the same authors in Iran (Sadegholvad et al., 2017a) reported a considerable overlap with the range of N&FS areas.

Although nutrition knowledge is a key component of health literacy (Spronk et al., 2014) and has been identified as essential for behaviour change (Worsley, 2002), knowledge alone is not sufficient to change health-related practices (Worsley, 2002). Other influential factors include price, convenience (Share and Stewart-Knox, 2012), and the availability of healthy options (Brown et al., 2015) need to be considered.

4.6. Conclusions

This study provided a framework of essential nutrition issues in conjunction with important food system topics for secondary school education programs, comprising four main areas. The development of this multidimensional guide, which incorporated food systems and ethical issues into health-related aspects of foods, occurred through interviewing different groups of food professionals. Several components of the 'Key nutrition messages to support a healthy lifestyle' and 'Skill development programs' in the current study are supported in previous literature. However, this study also added new components to these areas. 'Food Ethics education' and 'Foods from farm to plate', identified in current study are significantly underestimated in previous literature on school-based food education programs. Inclusion of all these four areas together in secondary school education programs may support the efficient interaction of the adolescents with food issues and may enable students to: make healthier food choices; to develop health promoting life skills; and, to make informed food choices that protect the environment, farm animal welfare, and local producers. Findings of this study may provide new insights for curriculum developers in Australia to further assess the strengths and gaps in N&FS components of the current secondary school curriculum.

The food professionals in this study were asked to express their opinion about essential N&FS knowledge issues for adolescents and were not asked to state their opinion regarding essential knowledge issues for children or adults more broadly. Future studies could target younger children's N&FS education or N&FS components of primary school curriculum.

4.7. Limitations

This study has contributed to one part of the picture of nutrition and food systems (N&FS) education in Australia. Other parts need to be identified by future studies beyond the professionals' views of essential N&FS knowledge issues for adolescents. A systematic investigation of current N&FS components of school curriculum would be useful to specify the strengths and gaps regarding

N&FS areas. How the current curriculum was developed and which groups of experts were involved in the development should be explored. It would also be very important to explore schoolteachers' views regarding N&FS components of the school curriculum. At the same time, it is critical to identify how confident and informed schoolteachers are in educating adolescents about N&FS topics. Further areas for future research may also include: current knowledge of secondary school students of wide range of important N&FS issues; the average school hours that are currently allocated for N&FS education programs in secondary schools in Australia; and, identification of the maximum time that secondary schools' curriculum in Australia can allocate for N&FS education.

Interviews commenced in 2012 and finished in 2014. A national school curriculum in Australia was introduced after the collection of data in this study and it is not clear the extent to which the participants' issues have been addressed in the new curriculum, which is still in the implementation phase.

It would have been desirable to review and discuss the findings of this study with the participants. However, as reflected in the long period of time necessary to include all of the participants for data collection, the additional time required for such a review was not feasible.

The variety of the recommendations of the participants and identified themes in this study largely depend on the nature of the participants' professions. Broader sampling of other food professionals, for example agronomists and senior physical education teachers, may provide a broader set of knowledge and skill recommendations.

4.8. Acknowledgements

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4.9. Authors' contributions

This study was designed by Sanaz Sadegholvad, Heather Yeatman, Anne-Maree Parrish and Anthony Worsley. All interviews were conducted by Sanaz Sadegholvad. Although Sanaz Sadegholvad collected and analysed the data, Heather Yeatman supervised different stages of the data collection and data analysis. Sanaz Sadegholvad developed the first manuscript, and then authors reviewed and improved the final manuscript.

Conflicts of interest: There is no conflict of interest related to this investigation

Chapter 5: Australian study, part 2

This chapter shows the second part of the Australian study. It answers the questions:

- 1) What aspects of nutrition and food systems knowledge do you think school-leavers are well informed about? Why?
- 2) What aspects of nutrition and food system knowledge do you think school-leavers are not well informed about? Why?

This was undertaken through a qualitative investigation of Australian food professionals' perceptions regarding the status of Australian school-leavers' knowledge of nutrition and food systems (N&FS). Semi-structured interviews were conducted with 21 prominent food professionals in Australia. The study identified strengths and gaps in Australian school-leavers' knowledge of N&FS and factors that influence school-leavers' N&FS knowledge.

This chapter was published in the peer-reviewed *Australian and New Zealand Journal of Public Health* (see Appendix 2) in the course of this PhD degree. It is presented here with minimal modifications to formatting, related to referencing style and page layout, to create a cohesive document and to follow the University of Wollongong's recommended referencing style.

In addition, two figures (Figures 5.1 and 5.2) are included in this chapter that were not published in the journal article due to word limits.

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Authors' contribution: This study was designed by Sanaz Sadegholvad, Heather Yeatman, Anne-Maree Parrish and Anthony Worsley. All interviews were conducted by Sanaz Sadegholvad. Sanaz Sadegholvad collected and analysed the data, and Heather Yeatman supervised different stages of the data collection and data analysis. Sanaz Sadegholvad developed the first manuscript, and the other authors reviewed and improved the manuscript.

5.1. Abstract

Objective: To explore Australian experts' views regarding strengths and gaps in school-leavers' knowledge of nutrition and food systems (N&FS), and factors that influence school-leavers' N&FS knowledge.

Method: Semi-structured interviews were conducted with 21 highly experienced food-related experts in Australia. Qualitative data were analysed thematically using Attride-Stirling's thematic network framework.

Results: Two global themes and several organising themes were identified. The first global theme, "structural curriculum-based problems", emerged from three organizing themes of: inconsistencies in provided food education programs at schools in Australia; insufficient coverage of food-related skills and food systems topics in school curricula; and the lack of trained school teachers. The second global theme, "insufficient levels of school-leavers' knowledge of N&FS", was generated from four organizing themes, which together described Australian school-leavers' poor knowledge of N&FS more broadly and knowledge translation problems for everyday practices .

Conclusion: Study findings identified key problems relating to current school-based N&FS education programs in Australia and reported knowledge gaps in relation to N&FS among Australian school-leavers.

Implications: These findings provide important guidance for N&FS curriculum development, to clearly articulate broadly-based N&FS knowledge acquisition in curriculum policy and education documents for Australian schools.

Key words: Australian experts, school-leavers, nutrition and food systems (N&FS), knowledge

5.2. Introduction

The Australian government has identified chronic diseases and conditions as a National Health Priority Area (NHPA) which requires particular attention because of the substantial burden they impose on the Australian population (Australian Institute of Health and Welfare, 2016). At least four of the nine NHPAs (Australian Institute of Health and Welfare, 2016), cardiovascular disease, obesity, diabetes mellitus, and cancers, are affected by dietary intakes (World Health Organization, 2003). Weight gain and diabetes can occur due to over consumption of foods high in sugar, fat, salt and low in micronutrients (Daraganova and Thornton, 2013). Risk of cardiovascular diseases increases with high intake of salt, saturated fats, trans fats and low intake of fruits and vegetables (World Health Organization, 2003). Low intakes of fruit and vegetables increase the risk of some types of cancers (World Health Organization, 2003). In Australia and globally, low consumption of fruit and vegetables together with high consumption of poor nutrient, energy-dense foods have generated major public health concerns (Daraganova and Thornton, 2013).

To support appropriate dietary intake, nutrition education programs have been developed for particular population groups or entire communities (Spronk et al., 2014).

Nutrition education in schools offers a unique opportunity to integrate the nutrition education and the application of that knowledge to achieve behavior change (Tab, 1999: 47).

Nutrition education in schools should not only provide nutrition information, but should also develop food-related skills and behavior in relation to: food preparation, food storage, socio-cultural aspects of consumption, and to improve positive body image and self-esteem (Pérez-Rodrigo and Aranceta, 2003). Studies in both Western (Pérez-Rodrigo and Aranceta, 2003; Carraway-Stage et al., 2015) and non-Western (Kazemian et al., 2014) societies report that food and nutrition education programs need to be reinforced in schools. While school-based nutrition education interventions have been explored in Australia (Gibbs et al.,

2013; Ritchie et al., 2015), gaps in school-based N&FS education programs and its association with current student knowledge of N&FS issues have not been explored more broadly.

Australian literature shows a broad assessment of Australians' knowledge of different aspects of food and nutrition to promote better health outcomes. For example: knowledge relating to understanding food labels in relation to health food choices (Mhurchu and Gorton, 2007); knowledge of food safety to prevent food borne illnesses (Worsley et al., 2013); knowledge of foods and nutrients in relation to the risk of metabolic diseases (Worsley et al., 2014); and general nutrition knowledge as one of several factors influencing dietary behavior (Hendrie et al., 2008a).

While the focus of the majority of existing studies has been on nutrition knowledge to improve health conditions, more recently the Australian literature introduced the notion of environmental sustainability relating to dietary intake (Friel et al., 2014; Public Health Association of Australia [PHAA], 2015a;). In 2015, the Public Health Association of Australia (PHAA) published a document on ecologically sustainable diets, which supported integrating principles of ecological sustainability into Australian Dietary Guidelines (PHAA, 2015a). It stated that :

... ecologically sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable, nutritionally adequate, safe and healthy, while optimizing natural and human resources (PHAA, 2015a: 1).

However, the current Australian diet is not consistent with healthy dietary recommendations and does not support environmental sustainability (PHAA, 2015a).

There is a lack of research addressing Australians' knowledge of a wide range of issues associated with food production from farm to fork in conjunction with

sustainability of food production and environment. However, within both international and domestic literature there is reference to the effects of environment (Lea, 2005), natural resources and sustainability of food production (Harmon and Maretzki, 2006b).

This study explored knowledge of traditional nutrition in conjunction with food systems to take a broader view of food-related issues. At present, specific aspects of food systems knowledge have been explored or incorporated into Australian literature. For example Worsley and colleagues (2015a) explored Australian adults' knowledge of agriculture and Taylor and Signal (2009) explored Australian consumers' self-reported knowledge of animal welfare and their willingness to pay for animal welfare friendly food products. However, to the best of our knowledge, literature assessing Australian's knowledge of a wide range of food systems issues is not available. Very limited studies world-wide have examined populations' knowledge of food systems. One exception is the study by Harmon and Maretzki who explored high school students' knowledge of food systems in relation to food systems sectors, sustainability, agriculture, food origins, local foods and hunger (Harmon and Maretzki, 2006b).

To address some of these gaps in the literature, particularly from Australia, this qualitative study aimed to explore the perspectives of experienced food-related experts in Australia regarding the strengths and weaknesses of school-leavers knowledge in relation to N&FS more broadly. This study also aimed to identify experts' views of the key determinants of current knowledge (and gaps in knowledge) of Australian school-leavers.

5.3. Method

To assess the broader aspects of nutrition and food systems, this study aimed to interview 20 prominent experts from various food-related fields including public health nutrition, dietetics, nutrition science, food sciences, home economics, veterinary science and environmental sciences. Purposive sampling was used (Coyne, 1997) to recruit a group of acknowledged academics from top ranked Australian universities, and highly experienced experts from governmental and

non-governmental organizations in Australia. Experts' years of experience and of their contributions to N&FS education programs and food-related research were determining for selection of participants. To identify the most appropriate participants from different groups of nutritionists, food scientists, environmental scientists, and other food-related experts, the first and second investigators of this study performed a thorough web-based investigation of staff profiles of all relevant schools or departments from top rank Australian universities. Potential participants needed to be involved in food-related knowledge and/or education research in Australia and/or active in young Australians' education programs. Some of the participants were Heads of the schools and chairs. Overall, the positions of the majority of participants were situated at the top of the career hierarchy within their organisations. A similar web-based investigation was performed in relation to various Australian organization that were active in nutrition education, health promotion, welfare of consumers, welfare of farm-animal and suitability of environment, aimed to identify proper participants. Afterward some of the potential participants were searched through research gate and LinkedIn for further assessment of their contributions to N&FS issues (e.g. their publications). The experts were selected from four States (New South Wales, Queensland, Victoria, Western Australia) and one Territory (Australian Capital Territory) of Australia.

Semi-structured interviews were conducted to explore experts' views regarding nutrition and food systems knowledge of Australian school-leavers and to identify key factors affecting their current knowledge. The interviews were conducted over an extended period, August 2012 to March 2014, due to constraints on availabilities of the lead researcher and of the research participants, all prominent experts in their field. The interviews were not conducted evenly over this time. The first and second authors invited the selected experts to participate by email. The dates and time for the interviews were then arranged by email. Approximately ten days prior to each interview the participant's information sheet, interview questions and consent form were emailed to the participants. In addition, participants were asked to give their consent at the beginning of each interview, which was audio-recorded. Eight

interviews were conducted face to face and 13 were telephone-based. The format of the interview was determined by participants' preference and/or the geographical location of the participant. The venues for face-to-face interviews were chosen based on interviewees' preferences. The first author undertook all interviews. Some of the participants were known to her through professional events or co-location at the same institution, but there was no prior professional relationship with any of the participant. Each interview lasted between 15 to 50 minute. Recorded interviews were transcribed verbatim for analysis.

Ethics approval was obtained from the Human Research Ethics Committee at the University of Wollongong. The participants' identities were de-identified using numbers to preserve anonymity. Four broad open-ended questions were designed by investigators of this study and were reviewed by a panel of 4 acknowledged academics with strong food and nutrition background from University of Wollongong. Open-ended questions used for the interviewees were:

- 1) What aspects of nutrition and food systems knowledge do you think school-leavers are well informed about?
- 2) Why do you think their knowledge is good in these areas?
- 3) What aspects of nutrition and food system knowledge do you think school-leavers are not well informed about?
- 4) Why do you think their knowledge is poor in these areas?

5.4. Data analysis

Interview transcripts were analyzed using the Attride-Stirling thematic network analysis framework (Attride-Stirling, 2001). This method provides a step-by-step guide for thematic analysis of qualitative data (Attride-Stirling, 2001). The first step involves reading and re-reading the interview transcripts to become familiar with the data and to identify lowest order codes (basic themes). The first author coded the data set and selected all of the basic themes after several reviews of the interview manuscripts. The second step was to identify the connected basic themes and group them together as middle-order themes (organizing themes).

The first and the second authors reviewed the basic themes and agreed on the arrangement of organizing themes and labels for them. The third step was related to the generation of the global themes. At this stage the main claims or the higher order themes were formed by appropriately grouping the organizing themes. After generating all levels of themes, the transcripts were reviewed several times to check the thoroughness of the generated organizing and global themes. Final agreement was reached in relation to the levels of themes, and labels for the organizing and global themes (Attride-Stirling, 2001). Two global themes were generated in this study. As based on Attride-Stirling's recommendation, each of the global themes produced a thematic network, shown as web-like illustrations in the results section of this study.

5.5. Results

5.5.1. Characteristics of the participants

Twenty one experts were interviewed, at which point data saturation was achieved. The experts included: four home economists, three public health nutritionists, four nutritionists, four dietitians, two food scientists, one environmental scientist, two veterinary physicians (experts in animal farm food production systems and animal welfare issues) and one expert in population health. They were all, in some way, engaged in N&FS education programs in Australia, were regularly in contact with youth in Australia or were active in food-related issues associated with young adults. Their connections with young population groups were mainly through: teaching at universities and schools; engagement with food-related issues as food educators or informants in governmental and non-governmental organizations; or involvement in food knowledge research projects.

5.5.2. Thematic network

The experts' views of the current knowledge of Australian school-leavers about nutrition and food systems issues centered on two global themes and several organizing themes. The first global theme was "structural curriculum-based

problems in current N&FS education programs at schools”. The second global theme was “insufficient levels of school-leavers’ knowledge of N&FS”. These two global themes emerged from several organizing themes. One of the emergent organizing themes did not directly align with either of the formed global themes; ‘competing roles of media and marketing and of schools in N&FS education’. All global and organizing themes are explored below.

5.5.3 Global theme 1. Structural curriculum-based problems in current nutrition and food systems education programs at schools

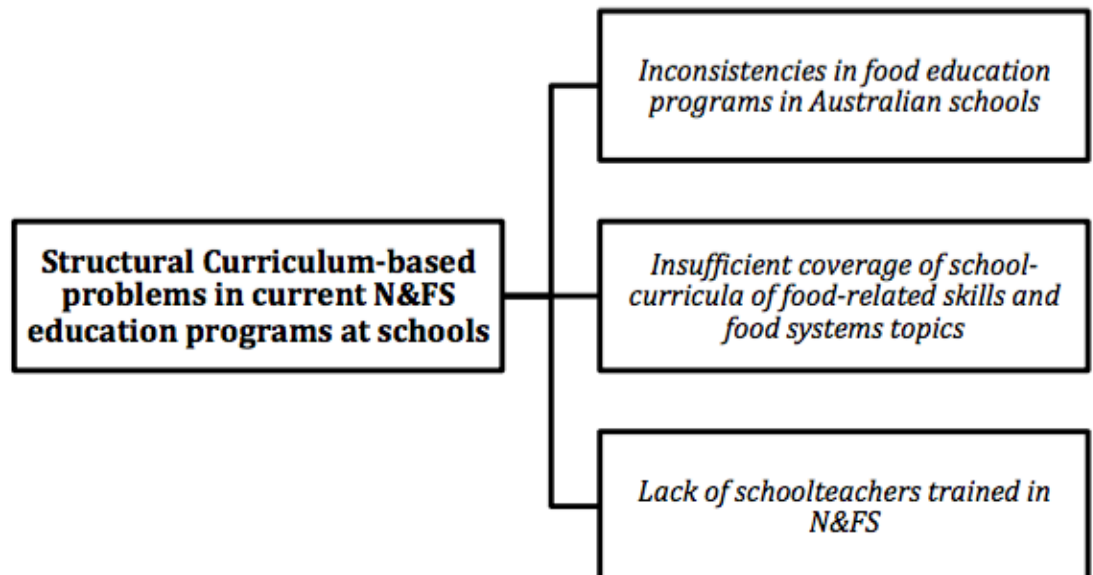


Figure 5.1 First global theme, “Structural curriculum-based problems in current N&FS education programs at schools

The interviewees believed that there are some “inconsistencies in food education programs in Australian schools” (organizing theme 1). They reported that students from different schools and students within different educational levels or years do not have the same exposure to nutrition-related education programs. For example, students have varying opportunities to experience: skill-based food education programs (e.g. cooking and gardening); educational excursions to visit

the process of food production 'from farm to fork'; and preparation and analysis of food records. A structural issue that was not directly curriculum-based was identified relating to the role of school canteens. Some participants expressed a view that school canteens should promote healthy food and drink choices, which would be a mechanism to send nutritional health messages, however healthy canteens are not equally provided across all the Australian schools

Kids in New South Wales could be in a school where there is no cooking involved, and if they do have cooking there's no specific area to do the food preparation, it might just be a converted classroom, it might just be for a couple of recipes only for one term. (Participant #2)

Some experts reported "insufficient coverage of school-curricula of food-related skills and food systems topics" (Organizing theme 2) due to crowded curriculum and lack of interest by curriculum developers and schools.

Um, I don't think they learn about the food system at all. If they're lucky they might do some history sort of related to it but I don't think they learn anything about the food systems, and I think that's because it's not core curriculum. (Participant #10)

We have a very crowded curriculum and often the food skills component is, is not really considered a priority in our schools today it's a life skill that's really important but many schools don't actually incorporate food skills as an important life skill because they're more focussed on academic. (Participant #3)

Interestingly, some participants commented on the lack of interest of food manufacturers to improve students' knowledge and concerns regarding particular foods, and their lack of involvements in school-based education. They considered it could be useful for some food manufacturers to engage in nutrition education initiatives so that young people have a better understanding of the manufacturing and food processes.

I don't think it's [food systems] considered important as part of school and I don't think there's a lot of reason for manufacturers themselves to

promote that knowledge. So it's in nobody's interest to do it so it doesn't get done. (Participant #12)

“Lack of schoolteachers trained in N&FS” (Organizing theme 3) was reported as a critical problem by home economists, public health nutritionists, dietitians and nutritionists. These experts believed that not all N&FS information provided by schoolteachers in Australia is thorough, accurate and updated enough to ensure school-leavers' knowledge of N&FS is at an appropriate level. Some of these interviewees related this problem to the lack of attention from the departments of education to monitor schoolteachers' knowledge of N&FS.

This whole problem about food and nutrition is because they don't have a specialist teacher teaching it ... On paper it looks right but in reality they're not getting the right people to deliver this message. (Participant #2)

5.5.4 Global theme 2. Insufficient level of school-leavers' knowledge of nutrition and food systems

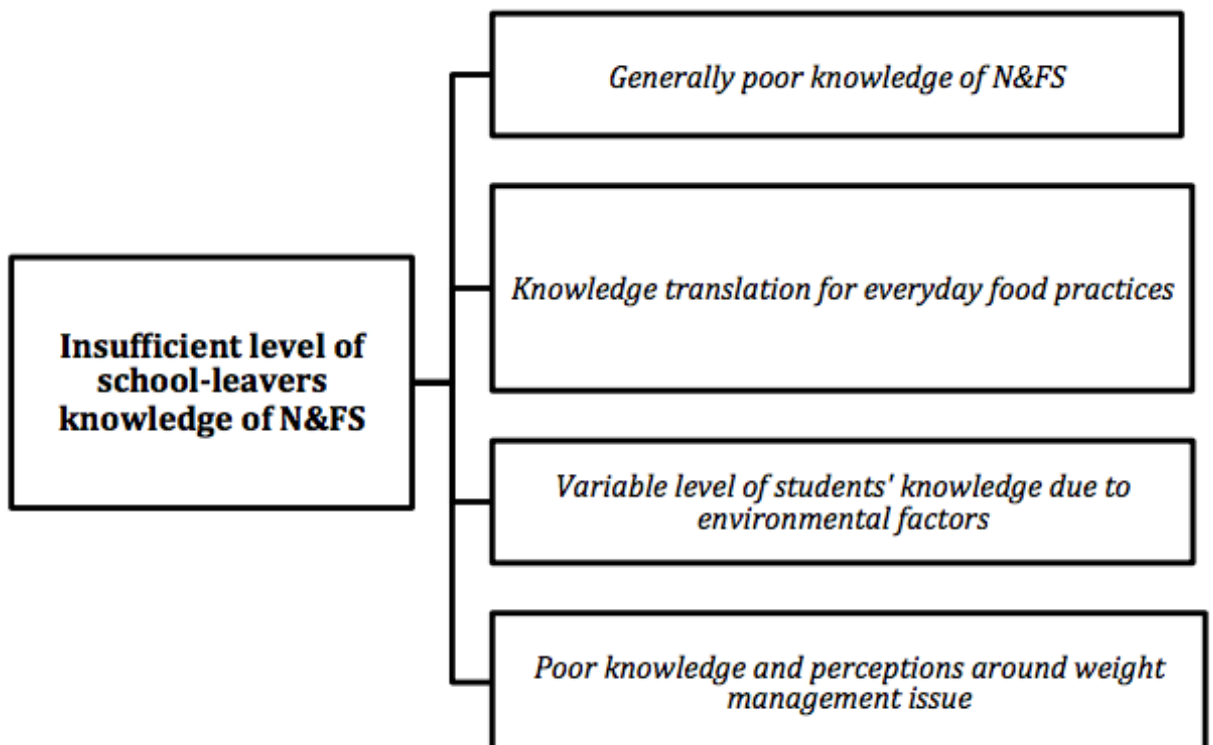


Figure 5.2 Second global theme, “Insufficient level of school-leavers’ knowledge of N&FS”

The participants from different groups of experts believed that Australian school-leavers have “generally, poor knowledge of N&FS” (organizing theme 1). It was commonly assumed that school-leavers have some knowledge of very basic nutrition issues such as: healthy versus unhealthy foods; the food pyramid or the food plate; and dietary sources of vitamin D & C; but it was not sufficient overall.

They are pretty informed about good and bad foods... things like fruit and vegetable are good for you. (Participant #16)

Informants believed that school-leavers lacked knowledge in relation to important nutrition issues such as: glycemic index; added sugar; added salt; nutrition during pregnancy; nutrition for early childhood; micronutrients’ deficiency especially in relation to iodine, iron and folic acid; and food storage, food hygiene and cross contamination. Interviewees reported they believed that Australian school-leavers had particularly poor knowledge in relation to food skills and food systems (particularly food production from farm to fork in conjunction with environmental sustainability and animal welfare).

They don’t necessarily know how to prepare and plan core foods. (Participant #7)

I don’t think they’re very well informed about how food is produced and it’s not just school leavers it’s general public ... the processes that all food goes through ... as it’s grown and then as it’s provided to the retailer. I don’t think people know very much about at all. (Participant #12)

The issue of “Knowledge translation for everyday food practices” (organizing theme 2) was reported by some experts, particularly nutritionists, home economists and public health nutritionists. These interviewees noted that although school-leavers might be aware of some nutrition basics, their

knowledge is not sufficient or useful enough to be translated into everyday practices.

Look they get taught the basics of what's a carbohydrate; what's a protein; what's a fat – I mean I think most children would understand that but it becomes not so clear when they're eating mixed meals ... So it's about how to combine, I think that's what they don't necessarily get. It tends to be very focused on "let's talk about calcium" or "let's talk about fruit and veggies and what's good about that" so it's not sort of brought together for the kids that are in a comprehensive manner. (Participant #6)

Many of the participants reported they thought there was a "variable level of students' knowledge due to environmental factors" (organizing theme 3), which is overall skewed toward poor knowledge of N&FS. They believed that schools, families and geographical location affected the level of N&FS knowledge across Australian school-leavers. For example it was noted that parents who have more appropriate knowledge and practices regarding food-related issues could positively affect their kids' knowledge and behavior. Also some experts expected better knowledge and skills of food production (e.g. growing and harvesting food products) among those who are living in rural regions and belong to farmers' families. In addition some interviewees believed there were gender differences in relation to levels of nutrition knowledge (e.g. "generally on some issues females have better knowledge than males" (Participant #8).

I think its variable depending on their experiences throughout school and it really struck me from doing my own research that potentially in some of the lower income areas kids may in fact have actually more skills because they might have been more likely to do home economics. (Participant #4)

Now it's not just about teachers of course ... what do their parents really know about it because parents are their teachers as well. (Participant #7)

Some of the nutritionists, dietitians and public health nutritionists had a view that "students have poor knowledge and perception of weight management"

(organizing theme four). The interviewees' main concerns were when a student focused on body image issues and inappropriate methods for weight loss.

Many of them want to lose weight - either they don't need to, or they have completely the wrong ideas. (Participant #21)

5.5.5 Competing roles of media and marketing and of schools in nutrition and food systems education

In this study some of the experts with stronger nutrition backgrounds (nutritionists, public health nutritionists, dietitians and home economists) referred to the important role of informative and mis-leading advertisements in impacting food-related awareness of Australian children and young adults. Some of the informants believed that schools are not sufficiently using their potential to educate students about food marketing.

I think almost every kid knows that milk has calcium and I think they know them [sic] because people selling those products use it in their advertising information. (Participant #1)

Some interviewees reported that media have substantial influence over the nutrition awareness of students, perhaps to a larger extent than school education. However "education by media" is not always appropriate since the media may present "extreme" and sometimes incorrect nutrition messages.

I think the school-leavers [are] probably more influenced by the media than what they are getting in school curriculum. I think the media sensationalises studies, and that sensationalism means that the message is not a moderate message it's an extreme message and that extreme message means that you're going to have ... you're going to have contradictory findings in different studies. (Participant #11)

5.6. Discussion

This qualitative study explored the views of experienced Australian food-related experts in relation to strengths and weaknesses of Australian school-leavers'

knowledge of nutrition and food systems (N&FS) broadly, which has not yet been explored in the literature. Lack of understanding of what school leavers know about the N&FS is an important omission, given that the importance of school-based food education programs designed to enhance healthy eating behaviors of students has been reported (Fordyce-Voorham, 2011; Peralta et al., 2016). In addition literature has reported the importance of food systems knowledge and the need for broadening the scope of nutrition education by adding ecological, agricultural, social and economic aspects of food to health-related topics (Harmon and Maretzki, 2006b). In the current study, several themes emerged from the experts' views of Australian school-leavers' knowledge of N&FS.

Interviewees' identified several problems they believed were associated with current N&FS education programs at schools. Participants believed that N&FS education at schools is not generally sufficient and students from different schools do not receive the same N&FS education. This is at odds with the 2014 Australian Curriculum Assessment and Reporting Authority's report related to the Australian Curriculum Health and Physical Education (Australian Curriculum Assessment and Reporting Authority, 2014) stating food and nutrition should be taught across the Health and Physical Education curriculum from Foundation to Year 10. However it is not surprising as there is a lack of studies that compare the consistency and sufficiency of school-based N&FS education programs as they are provided in Australian schools. Inadequate school-based nutrition education program has been reported in a study of classroom-based fruit and vegetable preparation for primary school students in Australia. This study mentioned a lack of programs that promote fruit and vegetable intake in school setting, and concluded that involvement in the preparation of fruit and vegetables is likely to encourage children to eat and enjoy fruit and vegetables more (Ritchie et al., 2015). However, international studies have undertaken some exploration in relation to the adequacy of school-based nutrition education programs. For example a study of school health programs and policies across all States of the United States in 2006 found that over a one year period teachers provided approximately four hours of nutrition and dietary behaviors instruction at the

elementary and middle school level and nearly six hours at the level of high school (Kann et al., 2007). No similar study has been reported in Australia.

The lack of trained Australian schoolteachers to implement school-based N&FS education identified by this study's participants may provide one reason why the teaching of N&FS is not sufficient or consistent. This reported lack of teacher skills is consistent with recent literature related to Australia, which stated that although teachers' preparation to teach food-related issues is critical, "currently in Australia there is no guarantee (or mandate) that pre-service teachers are taught food education within their university degree" (Elsden-Clifton et al., 2015: 87). At present there is not sufficient evidence of directives by the departments of education or actions by tertiary institutions to support the education of schoolteachers in N&FS issues and provide regular updates of teachers' knowledge. The continuation of the basic need for teacher preparation is surprising, given the rhetoric regarding the importance of tackling childhood obesity period. Clearly other topics are privileged within school curricula over the health of children.

Schoolteachers' lack of efficiency in training students about food-related issues is likely to be a worldwide challenge. Stage and colleagues in a recent investigation in the United States highlighted that schoolteachers have the potential to influence eating behavior of students extensively (Stage et al., 2016). However, they found that teachers spend limited hours on nutrition education for students and barriers included insufficient professional development and lack of knowledge of complementary materials. These researchers highlighted the need to focus on improving teachers' self efficacy to teach nutrition issues (Stage et al., 2016).

In the current study, insufficient levels of school-leavers' knowledge of N&FS reported by the participants is of concern, especially in relation to basic matters such as food hygiene. This view of the experts in this study is consistent with the findings of a recent study of 475 students from secondary schools and universities in Australia and the UK, which revealed generally low levels of food safety knowledge (Mullan et al., 2015). Poor knowledge of school leavers may

also translate into poor levels of adult knowledge. A 2011 study of 2,022 Australian consumers reported adults had poor knowledge of food safety (Worsley et al., 2013). It should thus not be surprising that annually in Australia there are approximately 4.1 million domestically-based cases of foodborne gastroenteritis (The OzFoodNet Working Group, 2011).

In the current study the experts also reported that school-leavers did not have an understanding of nutritional requirements in early childhood. This knowledge was identified necessary as some of the school-leavers might be parents in the near future. Parents have responsibility for their children's dietary behaviors and parents have been a focus of public health interventions that have aimed to improve children's dietary habits (Clark et al., 2007). The perception of participants in this study of a lack of knowledge about nutritional requirements in early childhood is consistent with an investigation of 439 Australian parents of children under five regarding knowledge and acceptance of infant and young children's public health feeding recommendations. That study concluded that "awareness and acceptance of infant feeding recommendations in Australia is poor" (Berry et al., 2012: p.31).

Not all of the identified areas of poor N&FS knowledge in this study have been assessed previously in Australian studies. This study has highlighted a perceived lack of students' knowledge of the process of food production from farm to fork, as well as issues relating to environmental sustainability and animal welfare. The importance of knowledge of these food systems related topics could be defined in the context of the need for citizens to improve their food choices toward more ecologically friendly and sustainably produced food products, which is supportive of a sustainable food supply (Bissonnette and Contento, 2001), welfare of farm animals (Taylor and Signal, 2009) and sustainability of the environment (Lea, 2005). Such knowledge gaps identified in this study could be explored further in future research and suggest neglected areas of N&FS education at schools.

Some experts also believed there was variability in the level of N&FS knowledge among Australian school-leavers which may be the result of wider socio-

environmental factors including: family (parents' knowledge and practices), food education programs offered within attended schools, and geographical location (urban and rural). These factors may influence the level of knowledge among school-leavers and are reflected separately in Australian and international food-related knowledge studies. An Australian study of consumers' food safety knowledge indicated poor safety knowledge was negatively associated with health education at school (Worsley et al., 2013). International studies have also reported positive effects of school-based nutrition and food safety education on students' knowledge and behavior (Shen et al., 2015) (Zhou et al., 2016). In addition, the important role of parents' knowledge and behaviour on their children's understanding and practices of N&Fs related issues identified in the current study has also been reported in international studies on the (positive) influence of parents as role models for healthy eating behavior among teenagers (Rathi et al., 2016) and middle school students (Young et al., 2004). This reinforces the need to consider nutrition education in a wider context than just what may or may not occur in schools and the need to explore the potential to promote important N&FS topics within the supportive environment of the family.

Participants in the current study also believed that female school leavers had overall higher levels of nutrition knowledge compared to male school leavers. This is consistent with a quantitative study of demographic variation in levels of nutrition knowledge in the Australian community, which identified overall higher nutrition knowledge scores for female Australian participants (Hendrie et al., 2008a). Also international studies have identified higher knowledge scores of nutrition among female participants compared to males (Parmenter et al., 2000; Pirouznia, 2001). This might suggest the need to explore strategies that effectively engage male students in N&FS education programs at schools.

Several of the participants identified the potentially substantial effects of media on students' and school-leavers' awareness of food and nutrition issues. There were a few experts who believed that media could be even more effective the school setting. At the same time they expressed their concerns in relation to the media's immoderate food messages. This is consistent with a study of general

nutrition knowledge and the demographic variation among Australian community by Hendrie and colleagues that highlighted the mass media are key sources of nutrition information and misinformation in the community (Hendrie et al., 2008a). Approximately, one decade ago these investigators reported that media in Australia had favored low-carbohydrate, high-protein diets and acknowledged that such information was likely to be misleading among the public. Media attention in Australia has created doubt about the healthiness of foods rich in carbohydrate, which is not a message consistent with Australian dietary guidelines (Hendrie et al., 2008a). At the same time, Australian literature has highlighted that substantial outcomes can be achieved with reasonably small budgets for promotion of nutrition recommendations through mass media (Dixon et al., 1998). The successful outcomes of “Go for 2&5” campaign in Australia, which aimed to increase fruit and vegetable consumption, and constructive effects of mass media advertising through television, radio, press, etc., is an appropriate example (Pollard et al., 2008). Future research of school leavers’ knowledge of N&FS issues might address the relative influence of school based education and messages provided by mass media.

5.7. Limitations

An identified limitation of this study was that this study focussed on food-related experts’ views regarding current N&FS knowledge of school-leavers and did not assess school-leavers actual knowledge and skills in N&FS issues. Further research is required to assess Australian school-leavers’ knowledge of wide range of important N&FS issues. The other limitation was that preselected health teachers did not accept our invitation to participate in this study. Thus, this group of experts, who are in direct contact with students at schools, was not included among our interviewees. In addition, the participants, while expert in their professional field, may have varying familiarity with school-leavers level of knowledge.

5.8. Conclusion

Study findings indicated that there are major structural and curriculum-based issues impacting current N&FS education programs in Australian schools. The structural problems related to inconsistent and insufficient N&FS educational programs that are currently provided at schools, together with lack of appropriately trained schoolteachers. The findings have highlighted perceived key gaps in current N&FS knowledge of Australian school-leavers. Overall participants assumed that Australian school-leavers' knowledge of N&FS is not sufficient and translatable for everyday practices. The findings suggested that current knowledge of school-leavers is affected by some environmental factors, including the home environment and the influence of media and marketing systems. The study results also suggest potential neglected components of N&FS education within current school curricula. These findings provide important insights for N&FS curriculum developers and education policy makers to improve school-based N&FS education programs in Australia.

5.9. Acknowledgements

The investigators of the current study thank the experts who participated in this investigation.

Chapter 6: Australian study, part 3

This chapter presents the third part of the Australian study. It answers the key question:

- 1) What are the best strategies to increase Australian school-leavers knowledge of nutrition and food systems?

This was undertaken through semi-structured interviews with 21 prominent food professionals in Australia. The study identified a range of recommendations by Australian food professionals revealing appropriate strategies to educate adolescents about important nutrition and food system (N&FS) issues. These findings led to development of a scholarly guide for N&FS education programs for Australian adolescents.

This chapter was published in the peer-reviewed journal *Nutrients* (see Appendix 3) in the course of this PhD degree. It is presented here with minimal modifications to formatting, related to referencing style and page layout, to create a cohesive document and to follow the University of Wollongong's recommended referencing style.

Citation: Sadegholvad S, Yeatman H, Parrish AM, et al. (2017c) Professionals' recommended strategies to improve Australian adolescents' knowledge of nutrition and food systems. *Nutrients* 9(844): 1–12.

Author's contribution: This study was designed by Sanaz Sadegholvad, Heather Yeatman, Anne-Maree Parrish and Anthony Worsley. All interviews were conducted by Sanaz Sadegholvad. Sanaz Sadegholvad collected and analysed the data, and Heather Yeatman supervised different stages of the data collection and data analysis. Sanaz Sadegholvad developed the first manuscript, and the other authors reviewed and improved the final manuscript.

6.1. Abstract

Background: Education and policy measures within schools are valuable strategies to promote health. This study explored views of experienced food-related educators, researchers and policy-makers regarding their recommended strategies to improve Australian school-leavers' knowledge of nutrition and food systems (N&FS).

Methods: Semi structured interviews were conducted with twenty-one experienced food-related experts from across Australia. Interviews were conducted either by telephone or face-to-face. Recorded interviews were transcribed verbatim and analyzed thematically.

Results: Five central themes and five sub-themes were identified from food professionals' suggestions for best strategies to improve school-leavers' knowledge of N&FS. The central themes included: 1) specific improvements in schools' core curricula; 2) pre-service and in-service training of school teachers about N&FS; 3) training students to develop a critical mind about N&FS issues; 4) multidisciplinary collaborations to improve school-based N&FS education; and 5) a supportive N&FS education environment for students.

Conclusion and implication: These findings provide a guide for curriculum developers, educational policy developers, and food educators to incorporate the suggested N&FS strategies into Australian education programs in order to improve Australian school-leavers' knowledge and skills of N&FS issues. The results of this investigation also may assist the development of international N&FS curricula guides.

Keywords: education strategies; nutrition; food systems; knowledge; Australian school-leavers

6.2. Introduction

Education and policy measures within school settings are valuable approaches to improve health. Schools offer the most effective and efficient way to reach a large proportion of the community including young people, families, school staff and community members (Pérez-Rodrigo and Aranceta, 2003). The positive effects of school-based food and nutrition education programs to improve students' knowledge (Lee et al., 2005; Powers et al., 2005; Fahlman et al., 2008; Wall et al., 2012; Carraway-Stage et al., 2015; Shen et al., 2015), attitudes (Shi-Chang et al., 2004; Wall et al., 2012), preferences (Morgan et al., 2010; Wall et al., 2012), behaviour (Shi-Chang et al., 2004; Powers et al., 2005; Fahlman et al., 2008; Shen et al., 2015) and self-efficiency (McCarthy et al., 2012; Wall et al., 2012) are reported in literature from around the world. The ultimate purpose of school-based nutrition education initiatives is to support reductions in the burdens of nutrition-related health problems. Unfortunately, the prevalence of obesity among children and adolescents has become a critical global health challenge (Shen et al., 2015) and poor dietary behaviours are the leading contributor to burden of disease. In high-income countries changes in dietary intakes have resulted in over consumption of energy while diet quality remains poor (Huffman et al., 2010) and in middle and low-income countries there has been a dietary transition toward increased consumption of refined carbohydrates, added sugars and fats (Popkin et al., 2012).

Research indicates that healthy eating is associated with an increase in quality of life, life expectancy and decreases in nutrition-related chronic diseases such as cardiovascular disease, cancer and diabetes (O'Toole et al., 2007). Eating habits and preferences are shaped from childhood and gradually become part of an individual's routine (Birch, 1999). One important strategy to assist youth to appreciate and develop healthy dietary behaviours is to offer nutrition education programs and supportive food environment in schools (O'Toole et al., 2007).

In addition to traditional nutrition education for students, which is primarily designed to foster healthy dietary behaviours, there also is a need to improve students' knowledge of food systems and their capacities to think critically about

the wider impacts of their food choices (Harmon and Maretzki, 2006b). Food systems are defined as:

... the process of food production, distribution, preparation, and preservation; food use and consumption; the recycling and disposal of food wastes; and the systems that support this process including marketing, transportation, storage, and government services (Harmon and Maretzki, 2006b).

Food production and consumption connects people and the environment (Torjusen et al., 2001). It is important to promote among the public appropriate food choices that are supportive of sustaining natural resources, the environment and food systems, and knowledge of food systems has been recommended (Harmon and Maretzki, 2006b).

For decades experts have recommended food-related educational programs be incorporated into school curricula and delivered to enhance children's understandings (Dixey et al., 1999). School-based education programs should teach students not only the required, broadly-based N&FS knowledge but also the necessary skills such as making appropriate food choices, food preparation and food storage (Dixey et al., 1999; Pérez-Rodrigo and Aranceta, 2001; Sadegholvad et al., 2016). Nutrition education investigators have raised the need to use a wide range of teaching methods for school-based nutrition education programs (Pérez-Rodrigo and Aranceta, 2001; Sadegholvad et al., 2016). Selected methods need to be based on learning objectives "from classroom discussions, work- sheets and keeping food records; to shopping exercises, tasting, creating or drama" (Pérez-Rodrigo and Aranceta, 2001: 132). In addition, the World Health Organization's Information Series on School Health recommended a combination of various teaching methods for students to improve their knowledge, beliefs and skills (World Health Organization [WHO], 1998).

Specific learning approaches to improve students' nutrition knowledge or dietary behaviours are separately explored and recommended in the literature, such as integrating nutrition topics with other school subjects (Carraway-Stage et al.,

2015), food preparation and cooking activities (Ensaff et al., 2015; Ritchie et al., 2015), school gardens (McAleese and Rankin, 2007; Morgan et al., 2010), and game-based innovations (Amaro et al., 2006b; Sharma et al., 2015). Carraway-Stage and colleagues also suggest that in order to increase students' exposure to nutrition-related information in schools it is necessary to integrate nutrition topics within other subjects (such as science) (Carraway-Stage et al., 2015).

Overall very few studies have focused on the identification of a full range of effective strategies to improve students' knowledge of nutrition and food systems during formal schooling. One study, a systematic review and meta-analysis of teaching approaches to promote healthy eating among elementary school students (Dudley et al., 2015), identified cross-curricular strategies and experiential learning methods as the most effective ways to improve children's dietary behaviours (Dudley et al., 2015).

In previous work we have reported on an investigation of experts' views of best strategies to improve Iranian school-leavers' knowledge of nutrition and food systems (Sadegholvad et al., 2016). That study identified the need for a multi-levelled, systematic approach that included three key components of: policy; the process of education; and supportive environments. A wide range of strategies was suggested to improve school-leavers knowledge of N&FS. Some of the identified strategies were: training school teachers, increasing skill-based and skill developing education programs at schools, developing critical thinking among students regarding food-related issues, and modifying inaccurate beliefs and traditions among Iranian students (Sadegholvad et al., 2016).

To the best of our knowledge there is a paucity of research into efficient and effective methods to improve Australian students' knowledge of N&FS during formal schooling. Therefore, this study aimed to develop a broad guide for strategies to improve Australian school-leavers knowledge of nutrition and food systems.

6.3. Materials and methods

The study interviewed highly experienced food and education professionals who were engaged in various nutrition and food systems (N&FS) fields, including: home economists, nutritionists, dietitians, public health nutritionists, food scientists, environmental scientists and veterinary physicians from four States (New South Wales, Victoria, Queensland and Western Australia) and one Territory (Australian Capital Territory) of Australia. Purposive sampling method (Coyne, 1997) was employed to select an appropriate group of prominent professionals from these fields. The inclusion criteria were: highly experienced academics from top ranked universities of Australia; acknowledged policymakers who were involved in community nutrition education programs; and experts with key roles in professional governmental and non-governmental organizations. To select appropriate academics, the first and second authors performed a thorough web-based investigation of staff profiles from all relevant schools or departments from major universities in Australia. Potential participants were selected who were experienced in young Australians' food education programs or those who were involved in Australian food and nutrition education research. A similar web-based search was performed to identify a group of appropriate participants from Australian organizations who were active in nutrition education, consumer welfare, animal welfare and environmental sustainability. Further searches were performed in 'Research gate' and 'LinkedIn'. The investigators developed a list of forty eligible experts. The objective was to stop recruitment once data saturation had occurred (Elo et al., 2014). Ethics approval was granted from the Human Research Ethics Committee (Health and Medical) of the University of Wollongong (Approval No: HE12/277).

The first and second authors invited potential participants via email for face-to-face or telephone-based interviews. The experts who agreed to participate were issued with the participant information sheet, consent form and the interview questions. Interview dates/times and location were arranged via email. Before commencing each interview, participants provided an informed written and/or audio recorded verbal consent.

The first author conducted semi-structured interviews with each of the participants who participated in this study. Semi-structured interviewing methods (Cohen and Crabtree, 2006) provided the opportunity for interviewees to express and expand their views on the best strategies to improve school-leavers' knowledge of N&FS. Interview questions were developed by the authors and were confirmed with a panel of four experienced academics with food education and research backgrounds the University of Wollongong. Three key open-ended questions were used for all interviews:

- 1) What are the best strategies to increase school-leavers knowledge of nutrition and food systems?
- 2) What do you think could be done differently to increase their knowledge?
- 3) Do you have other suggestions for school-based N&FS education programs?

All the interviews were audio-recorded. The interviews were transcribed verbatim by a professional audio transcriber and reviewed and checked by the first author. Inductive thematic analysis (Braun and Clarke, 2006; Vaismoradi et al., 2013) was conducted using manual coding and the Nvivo 10 software program. In an inductive thematic analysis the researchers do not try to code the data to fit a pre-established coding frame or the investigators' analytic perceptions. This method of analysis is data driven (Braun and Clarke, 2006).

Steps described by Baum and Clerk (Braun and Clarke, 2006), and Vasmoradi and colleagues (2013) guided the thematic analysis. Initially, the first author read and reviewed all the transcripts several times to become familiar with the collected data. Initial codes were generated from the features of the entire data set. Potential themes were generated from the coded data by the first author and were reviewed, re-reviewed and named by the first and second investigators. The reviews of transcripts continued until no new themes emerged from the entire data set. All authors reached consensus in relation to the labeled themes for the final report. Finally, a brief report of identified themes and details of each theme and sample quotes were developed to present the findings in a clear strategic manner (Braun and Clarke, 2006; Vaismoradi et al., 2013).

6.4. Results

Data collection ended after interviewing twenty-one experts, when data saturation had occurred. All interviewees were experienced educators and/or prominent researchers from universities and/or governmental and non-governmental organizations. In addition some of the interviewees were involved in policymaking. Interviewees included three public health nutritionists, one public health expert, four dietitians, four nutritionists, four home economists, two food scientists, two veterinary physicians (experts in animal-sourced food production and animal welfare issues) and one environmental scientist. The recommended strategies to improve school-leavers' N&FS knowledge were organized into five central themes and five sub-themes described below. Identified themes are shown in Figure 6.1.

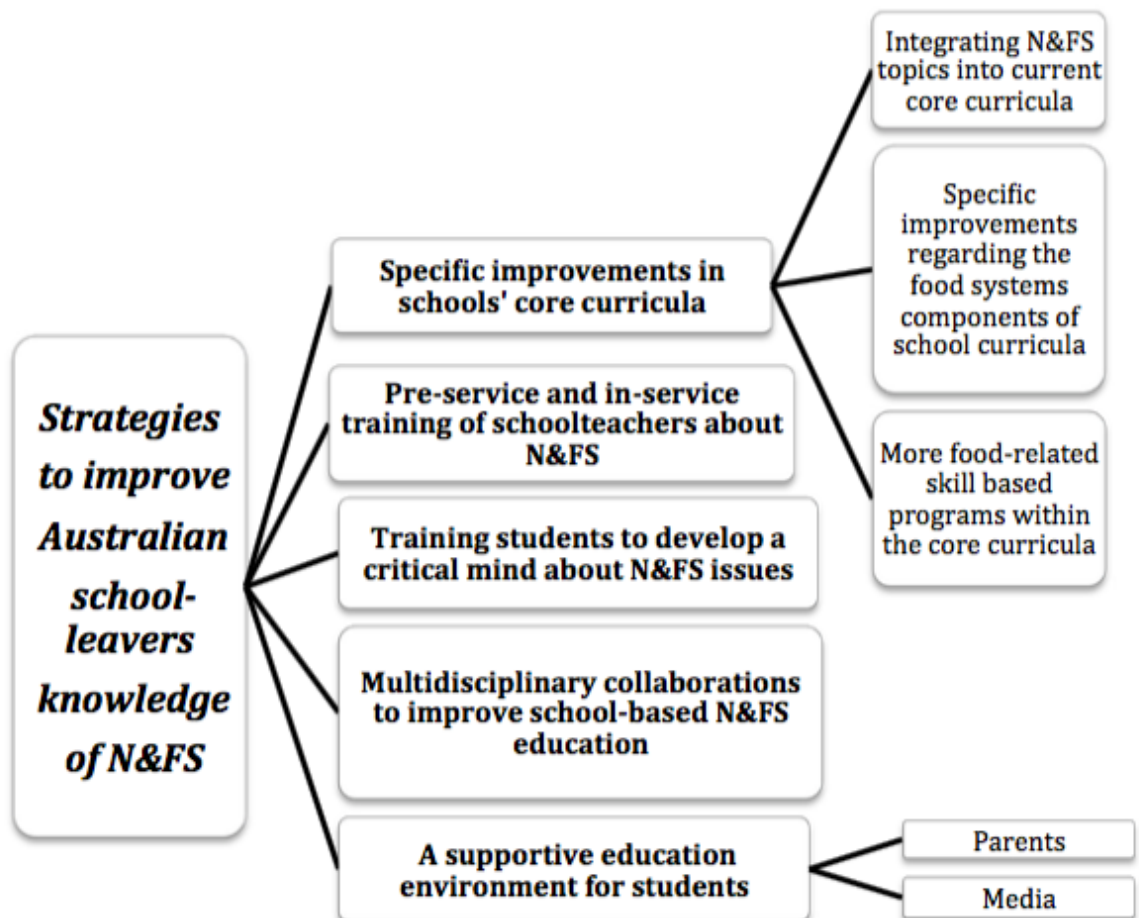


Figure 6.1 Professionals' recommended strategies to improve Australian school-leavers knowledge of N&FS

The interviewees from different groups of experts recommended three main strategies to improve the current core curricula of Australian schools. The first suggestion was to integrate N&FS topics into current core curricula. The second strategy was specific improvements in relation to the food systems components of school curricula. The third strategy was to increase food skills development within the core curricula. These three strategies are described separately below.

There was consensus across the different groups of interviewees that N&FS topics need to be integrated into current core curricula such as Science, Geography, History, and English Literature. Some interviewees noted that there was “very little chance” to allocate a separate subject for N&FS topics within school curricula. They stated that it was not necessary to have a separate subject for N&FS lessons because N&FS topics can be easily integrated into current core subjects. They also believed the integration of important N&FS topics within current subjects provided the opportunity for all students from across the Australia to receive an appropriate level of food-related education regardless of the schools they attend or subjects studied.

There is very little chance of getting a new solo called nutrition subject and that is not necessary ... Curriculum at schools can do this not by having a separate nutrition class, but integrating nutrition and food systems issues into the normal science curriculum ... into Biological Sciences, Geography, History, English Literature and other ... for example English teachers can get the students to write about food security questions ... get them in geography classes to write about water and food distribution, in history classes they can look at how food supply in Australia has changed or somewhere else has been changed since world war two. (Interviewee #21)

Most of the interviewees shared a common belief about the need for specific improvements in relation to the food systems components of school curricula, stating that the major focus of current school and community-based food

education programs are to improve health outcomes. However, some experts including public health nutritionists, nutritionists, dietitians, veterinary physicians and the environmental scientist emphasized the need to educate students about food production systems and more generally about food from farm to fork, in relation to both agriculture and animal-based food products. In addition several experts also believed some animal welfare and environmental sustainability information should be incorporated into lessons addressing food production systems.

I think that it is important to provide students with opportunities to gain an understanding and perhaps through visits to companies and projects and other things where they actually investigate how food is grown, how food is processed, how it gets to the consumer is an important part of learning about their life support systems. (Interviewee #10)

They need to know about what is a sustainable healthy food basket ... a basket of goods needs meet some nutrition requirements and anything over that is waste. ...they need to know about not using packaging ... They need to know about foods that they choose and sustainable food system and sustainable environment. (Interviewee #7)

The home economists and most of the interviewees with nutrition backgrounds (public health nutritionists, nutritionists and dietitians) reported that food skill programs like shopping, cooking, storing foods and gardening needed to be one part of the core curricula to assist school-leavers to improve their skills for everyday life. These experts focused on the importance of healthy cooking and food preparation courses for all students from primary school until school-leaving age.

First of all it is the shopping, it's the making a shopping list, making a healthy meal, knowing what to have in your pantry and refrigerator, seasonal ingredients so that's the food literacy skills then the food preparation the cooking skills. (Interviewee #6)

6.4.1. Pre-service and in-service training of schoolteachers about nutrition and food systems

The home economists and some nutritionists, public health nutritionists and dietitians frequently spoke of the critical need for training and re-training of school teachers about important N&FS topics to enable them to transfer accurate and updated information to students. Some of these interviewees noted the enrichment of school curricula with essential N&FS topic should be supported by adequate N&FS- pre- and in-service training for schoolteachers.

Teachers need to be better prepared and not assume they can teach it from no background. (Interviewee #6)

6.4.2. Training students to develop a critical mind about nutrition and food systems issues

Two interviewees involved in policy-making and food-related educators identified that students need to develop a broader view and a critical mind about food. These experts stated that students need to find the ability to think and discuss food-related issues in a multidimensional context. It was reported that students needed to achieve a general understating of social, political, environmental, economic and cultural aspects that are associated with food consumption, food production and food choices. Some interviewees believed students needed to learn to identify and search appropriate N&FS information sources and should learn basic research skills.

Integrate political issues, issues of public interest, encourage and teach them to think critically and ask them to write critical argument. They need to recognize how social, economic and political determinants influence our food consumption. (Interviewee #21)

6.4.3. Multidisciplinary collaborations to improve school-based nutrition and food systems education

Some interviewees recognized the challenges associated with the broad and multi-disciplinary nature of N&FS topics. They reported that it was necessary to create further collaborations among schools, Departments of Education and universities (and experienced experts from different food-related disciplines) to improve N&FS education programs in schools. This was considered necessary to ensure: the identification of all essential N&FS components of school curricula; the provision of regular updates relating to the N&FS components of school curricula; the provision of appropriate education and training for schoolteachers about N&FS topics; and the planning of food-related education programs for students.

We need to engage different educationalists to find how they can use food-related issues into current curriculum. I think we need to make sure that university level educators are having input into the school curriculum. I think, it should be cutting edge material that goes into that.
(Interviewee #8)

6.4.4. A supportive education environment for students

Interviewees from the different groups of experts stated that parents and the media need to create a more supportive environment to facilitate and support the process of educating students about N&FS. The experts' suggestions to improve the roles of parents and media are described separately below.

6.4.4.1 Parents

Some of the interviewees believed it was necessary to educate parents about N&FS issues in order to create a more supportive environment at home, which they considered was an important education setting for children. The purpose was to facilitate appropriate role models and to prepare well-informed food educators for the home setting. Some experts suggested changes in relation to students' knowledge, attitude and behaviour about food-related issues are

unlikely to occur without proper parental education. Building parents' knowledge and skills was identified as a solution to overcome time constraints and overcrowded school curriculum.

The parents, the school and the students, and teachers all are working together. That's really important because we could be teaching students but we also need to ensure that the parents are also involved so that it's always a team work approach. That's important, a whole school approach so that what we're teaching in the schools is also being underpinned and, and supported at home" (interviewee #15).

6.4.4.2 Media

Some of the interviewees from different groups of experts expressed the need for more educational food-related programs in the media rather than just food related entertainment. Some experts referred to popular cooking television (TV) shows in Australia which promote cooking and eating practices that are not consistent with the Australian Dietary Guidelines' recommendations. In addition some experts believed junk food advertising during children's programming on Australian TV distorts children's knowledge of appropriate eating habits. A further suggestion was for mass media to support public discourse by acknowledged food related experts.

If there was a master chef that focused on healthy eating I think it would be a wonderful initiative. I think all the cooking shows are probably doing more damage to our food supply than anything else because there is no regard to nutrition at all. There just, you know the standard thing of butter and lots of salt, lots of dairy fat, lots of everything that I would regard as something as a special occasion so it's kind of party food rather than everyday food. So a sort of Jamie Oliver in Australia would be a really good outcome. (Interviewee #4)

6.5. Discussion

This study explored experienced food professionals' recommendations of strategies to improve Australian school-leavers' knowledge of nutrition and food

systems (N&FS). Experts' suggestions addressed five key issues including: improvements in schools' core curricula; the importance of training school teachers about N&FS; training students to think more broadly and critically about N&FS issues; multidisciplinary collaborations to improve N&FS education programs in schools; and development of a supportive education environment for students by parents and media.

One strategy to improve the schools' core curricula was integrating N&FS topics into current core subjects. This finding is consistent with overseas studies that identified or made reference to successful interventions that integrated nutrition lessons with other subjects such as science, language and mathematics at schools (Nicklas and O'Neil, 2000; Pérez-Rodrigo and Aranceta, 2003; Carraway-Stage et al., 2015). An intervention study in the United States (US) involved the integration of nutrition within other school subjects over the course of one year (Carraway-Stage et al., 2015). The findings identified the positive influence of integrative food-based curriculum on students' nutrition knowledge in the intervention group compared to the comparison group.

The potential positive effects of an integrative curriculum on students' knowledge was identified in the current study but to the best of our knowledge there has not been reports of any studies that have investigated the effects and practicality of a separate subject for N&FS topics. Thus it is not possible at this time for food educators and researchers to compare the relative effectiveness of an integrative N&FS-based curriculum versus a separate subject for N&FS.

Another suggested strategy to improve school curricula was more skill-based programs within the core curricula from primary school to high school. The importance of food skill programs has been supported by studies that identified the positive effects of school-based gardening, or food preparation and cooking interventions on children and adolescents' dietary behavior (McAleese and Rankin, 2007; Morgan et al., 2010; Hartmann et al., 2013; Ritchie et al., 2015a). A recent systematic review and meta-analysis of teaching approaches to improve healthy dietary behaviour in primary school children (Dudley et al., 2015), identified that 'experiential learning approaches' such as gardening, food

preparation and cooking had the greatest effects compared to other approaches on increased knowledge of nutrition, reduced energy intake and increased intake and preference of fruits and vegetables (Dudley et al., 2015).

The interviewees in this investigation believed there was a need for specific improvements in education about food systems in Australian schools. Unfortunately, in Australia and internationally, food systems education programs have not been considered to be necessary, essential long-term learning objectives. In contrast, food systems investigators have highlighted the importance of students' food systems knowledge and the impacts of people's food choices on the sustainability of the environment and the food system (Harmon and Maretzki, 2006b; Parrish et al., 2016; Sadegholvad et al., 2016). The connection between people's food choices and food systems has been raised in studies focusing on the exploration of consumers' choices in regard to: local foods (Weatherell et al., 2003), organic foods (Torjusen et al., 2001; Magnusson et al., 2003) animal friendly food products (Heng et al., 2013) and environmentally friendly food products (Bissonnette and Contento, 2001; Magnusson et al., 2003). Incorporating more food system topics within current school lessons may support school-leavers' informed food choices by not only addressing health issues but also factors such as environmental and food system sustainability, farm animal welfare, and welfare of local producers and farmers.

The current study identified the need for training school teachers about important N&FS topics. No recent studies have reported on Australian schoolteachers' knowledge of N&FS issues. More than one decade ago a study in Australia explored trainee home economics and physical education teachers' knowledge, attitudes, and behaviours related to weight management, body image and eating disorders (O'Dea and Abraham, 2001). The findings revealed that while teachers had not received nutrition education, they did recommend diets to overweight teenagers despite their lack of knowledge in relation to adolescent nutritional requirements, weight management and fad diets. In addition the study reported uninformed views about eating disorders and use of inappropriate weight loss methods was identified among the studied teachers.

(O'Dea and Abraham, 2001). A recent study of 181 US teachers, who were responsible for the nutrition education of one million children from lower socio-economic backgrounds revealed only 3% of teachers answered four out of five nutrition knowledge questions accurately, 54% agreed that it was difficult to distinguish which nutrition information was reliable, and only 9% of teachers reported they followed healthy dietary behaviours. This study highlighted the importance of nutrition education for teachers to enable them to teach students about important nutrition issues and to improve their own dietary behaviours (Sharma et al., 2013).

Overall, despite the lack of recent literature identifying schoolteachers' knowledge of broad range of N&Fs issues, nutrition education researchers have confirmed the importance of equipping schoolteachers with adequate knowledge of nutrition to improve their willingness and confidence to teach nutrition-related lessons (Chen et al., 2010). In addition, Worsley and colleagues in a study of food knowledge related to Australia suggested that home economists programs may influence students' long-term food knowledge (Worsley et al., 2015c). Development of specific strategies to target schoolteachers' education needs may also be necessary. A recent cluster-randomised trial study of 20 school teachers in rural China (Wang et al., 2016) found that a comprehensive school-based nutrition program did not improve teachers' knowledge, behaviour and attitudes about nutrition. Thus teachers' involvement in interventions that primarily target students may not be sufficient to improve their own N&FS knowledge and skills.

The interviewees involved in the current study expressed the need for media to create a supportive education environment for students. Nutrition education researchers have highlighted the important role of television in distributing nutrition education messages, for example via broadcasted food advertisements (Scammori and Christopher, 1981). However, literature related to Australia has shown a lack of a supportive education environment of Australian television that has allocated most of the food advertisements to non-core foods (63%) (Roberts et al., 2013). The food professionals in the current investigation raised concerns

about popular cooking TV shows in Australia (e.g. Master chef), which portrayed dietary and food practices not consistent with Australian Dietary Guidelines. However, such views may be purely personal and not reflective of actual influence of such television programs. A recent Australian study identified that adult participants did not consider celebrity chefs and TV cooking shows affected their dietary intakes (Villani et al., 2015). Young people are also high users of social media and Australian studies have shown the effects of social media on particular dietary behaviours, such as risky alcohol consumption (Carrotte et al., 2016). At the same time, nutrition educators have underscored the positive potential of social media as a low-cost, quick and direct way to communicate nutrition messages (Tobey and Manore, 2014).

In addition to media, the interviewees of current study expressed the need for parents to create a supportive education environment for their children. The importance of this issue is revealed by Australian and overseas studies, which have reported the influence of parents on their children's dietary behaviour (Wyse Rebecca et al., 2010; Golley et al., 2011; Fletcher et al., 2013; Rathi et al., 2016). For example, an Australian study found that parents influence young children's eating habits, but often lacked the required nutrition knowledge and food skills to improve their children's dietary behaviour (Wyse et al., 2010). While this may be a useful suggestion from a school's perspective, a more holistic approach to N&FS education, it may be unrealistic. Parents may not consider they need to be 'educated' about N&FS issues. Parents also may not believe they have an education role with regard to their children's N&FS knowledge, which they may consider to be the school's responsibility. Further research needs to address this issue.

Not all identified N&FS education strategies identified in current study have been previously reported in the literature. For example, the experts in the current study believed there is a need to develop critical thinking in students in relation to N&FS issues. However, development of critical thinking in students in relation to food consumption, food choices, food production issues or more broadly N&FS issues has not been well addressed in the existing literature. Another finding of

this study was the importance of increasing multidisciplinary collaborations of schools, Departments of Education and universities. Such collaborations were identified as necessary to improve the quality and efficiency of N&FS education programs offered to students and schoolteachers.

6.6. Conclusions

The findings of this study provide important points for consideration to develop efficient and effective strategies to improve Australian school-leavers' knowledge of N&FS. The five key components included: improvements in schools' core curricula; training schoolteachers about important N&FS topics; developing critical minds about N&FS issues; multidisciplinary actions to improve N&FS education programs in schools; and improving the positive involvements of parents and media to create a supportive education environment for students. This information will assist curriculum developers, education policy developers, and food-related educators in their endeavors to improve school-leavers' knowledge and skills of N&FS issues and, in turn, to address key public health priorities in Australia.

6.7. Acknowledgments

The investigators of this research thank the experts, who participated in this study.

6.8. Author contributions

SS, HY, AMP and AW designed the study. SS conducted the interviews. SS and HY selected the participants, and then all the authors together developed the final list of potential participants. SS collected and analysed the data. HY supervised the data collection and data analysis. SS, HY, AMP and AW reviewed the analysed data. SS wrote the first manuscript. All authors read, amended and approved the final manuscript.

Conflicts of interest: The authors declare no conflict of interest.

Chapter 7: Iranian study, part 1

This chapter is related to the first part of the Iranian study. It answers the key questions:

- 1) What do Iranian school-leavers should broadly know about nutrition and food systems? Why?
- 2) What food-related skills do they need to develop? Why?
- 3) What are the most important issues to be included in their education curriculum? Why?

This was undertaken through semi-structured interviews with 28 prominent food professionals in Australia. The study identified Iranian food professionals' perspectives on essential nutrition and food systems (N&FS) knowledge issues for Iranian students before school-leaving age. These findings led to the development of a scholarly guide for N&FS education purposes in schools in Iran.

This chapter was published as a peer-reviewed journal article in the *Iranian Journal of Public Health* (see Appendix 4) in the course of this PhD degree. It is presented here with minimal modifications to formatting, related to referencing style and page layout, to create a cohesive document and to follow the University of Wollongong's recommended referencing style.

It is notable that, due to the huge gap in the literature in this area, Iranian participants preferred to focus on the whole of the formal education system, from when students begin school until their school-leaving. Therefore, this paper may guide both the primary and the secondary school curricula in Iran.

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Author's contribution: This study was designed by Sanaz Sadegholvad, Heather Yeatman, Nasrin Omidvar, Anne-Maree Parrish and Anthony Worsley. All interviews were conducted by Sanaz Sadegholvad. Sanaz Sadegholvad collected and analysed the data, and Nasrin Omidvar supervised different stages of the data

collection and Heather Yeatman supervised data analysis. Sanaz Sadegholvad developed the first manuscript, and the other authors reviewed and improved the manuscript.

7.1. Abstract

Background: This study aimed to investigate food experts' views on important nutrition and food systems knowledge issues for education purposes at schools.

Method: In 2012, semi-structured, face-to-face or telephone interviews were conducted with twenty-eight acknowledged Iranian experts in food and nutrition fields. Participants were selected from four major provinces in Iran (Tehran, Isfahan, Fars and Gilan). Open-ended interview questions were used to identify nutrition and food systems knowledge issues, which experts considered as important to be included in school education programs. Qualitative interviews were analyzed thematically using NVivo.

Results: A framework of knowledge that would assist Iranian students and school-leavers to make informed decisions in food-related areas was developed, comprising five major clusters and several sub-clusters. Major clusters included knowledge of nutrition basics, food production, every day food-related practices, prevalent nutritional health problems in Iran and improvement of students' ethical attitudes in the food domain.

Conclusion: These findings provide a guide to curriculum developers and policy makers to assess current education curricula in order to optimize students' knowledge of nutrition and food systems.

Keywords: nutrition, food systems, knowledge, school, Iran

7.2. Introduction

The literature across several nations, including Europe (Pérez-Rodrigo and Aranceta, 2003), United States (Carraway-Stage et al., 2015), and Iran (Kazemian et al., 2014) demonstrate the potential of schools to deliver important food and nutrition messages is yet to be reached.

The importance of food and nutrition education is discussed in the literature (Pérez-Rodrigo and Aranceta, 2001), but to date, there is little published research identifying what students need to learn about nutrition and food systems.

Globally, research has increasingly focused on school-based food skills programs for improved dietary practices, mainly relating to cooking skills (Mc Dowell et al., 2015). Different aspects of nutrition and food systems knowledge required for consumers to make informed food choices or to improve their dietary behaviors have been separately documented, covering a wide range of issues, such as food safety (Kennedy et al., 2005), use of food labels (Campos et al., 2011), cooking skills (Hartmann et al., 2013), and other food and nutrition topics.

Several assessment tools have been developed to measure particular sub-components of nutrition or food system knowledge such as dietary recommendations, food sources of nutrients, daily food selections, nutrition-related health problems (Wardle et al., 2000), food system sectors, food sources, sustainability, local foods and hunger (Harmon and Maretzki, 2006b).

A major gap in the literature to date includes the assessment of a broad range of important nutrition and food systems knowledge issues within one study. Consequently, there is little strategic guidance for food educators, education curriculum developers, and policy makers against which to assess and build comprehensive education programs. This research addresses this issue.

The “new nutrition science” (NNS) takes a broad view of nutrition and incorporates various food-related issues from different food and nutrition disciplines. The NNS reflects biological, social and environmental aspects of nutrition science that affect food systems and people’s food decision-making (Lawrence and Worsley, 2007). This multidimensional perspective has been neglected to date in the food and nutrition knowledge literature.

Food and nutrition knowledge literature related to Iran has three major focuses. First, studies which assess a target population’s knowledge of a particular nutrition and food-related issues such as food labels (Ahmadi et al., 2013), food groups (Ahadi et al., 2014), and food safety (Askarian et al., 2004). Second, studies which raise the importance of nutrition education for particular health-related outcomes, for example preventing obesity (Amirrood et al., 2014), osteoporosis (Ansari et al., 2014) and cardiovascular diseases (Tavassoli et al., 2015a). Third,

studies that investigate aspects of nutrition knowledge associated with balanced, healthy eating habits for particular populations. For example, research directed attention to nutrition during pregnancy (Fallah et al., 2013), adolescents' knowledge of healthy dietary behavior (Mirmiran et al., 2007), and knowledge for healthy eating among college athletes (Azizi et al., 2010). However, there is not study that identifies a broad range of nutrition and food systems issues essential for Iranians to know or a study that assesses Iranian's knowledge of the range of food-related issues.

Knowledge, as the focus of this investigation is a complex concept (Yang, 2003). The incorporation of the epistemology of knowledge framework will assist in understanding the study findings. The holistic framework of the epistemology of knowledge developed (Yang, 2003) based on three facets of knowledge, explicit, implicit and emancipatory, reflecting the different processes of knowing in adult learning. The explicit facet represents scientific aspects; the implicit facet reflects practice, and the emancipatory facet is carried by values and ethics (Yang, 2003). This approach is consistent with the multidimensional nature of the NNS, whose dimensions of knowledge cover scientific (explicit) aspects, food and nutrition-related skills and practice (implicit) and cultural and values-based (emancipatory) factors.

7.3. Methods

7.3.1. Participants

Participants were drawn from various food-related fields to ensure the research incorporated expert views on the different dimensions of nutrition and food system issues consistent with the New Nutrition Science (NNS). A mix of Iranian experts was identified for recruitment, including four public health nutritionists, four nutritionists, four dietitians, four food scientists, two environmental scientists, two veterinary physicians, two agriculture scientists and four high school teachers (health teachers and home economics teachers) across the country. Participants were recruited through purposive sampling and

snowballing. Experts were considered eligible for inclusion if they were acknowledged academics in top-ranked universities, practitioners who had key roles in professional governmental and non-governmental organizations, and recognized experts in private practice. Experts were invited to participate in person or by telephone. The dates and venues for the interviews were then arranged and participants were given the interview questions, participant information sheet and consent form (all in Farsi) prior to the interviews.

Ethics approval was received from the Human Research Ethics Committee (Health and Medical) of the University of Wollongong. Anonymity was assured and participants' identities were replaced with alphabetical letters and numbers on any potentially identifying materials such as notes, transcripts, and recordings.

7.3.2. Data collection

Open-ended interview questions were developed by the study authors and reviewed by an academic review panel. Questions explored the experts' attitudes regarding important nutrition and food systems knowledge issues for Iranian school-leavers. Semi-structured face-to-face or telephone interviews were conducted with invited experts between September and Dec 2012. Interviews lasted between 15-120 min.

All interviews were conducted in Farsi by the first author for whom Farsi is her first language. Interviews were recorded using two recording devices to ensure a backup. The first author transcribed the interviews in Farsi and then translated them into English for analysis. Examples of the interview questions are:

- What do you consider the average school-leaver should broadly know about nutrition and food systems? (What do students need to learn before school-leaving age?)
- If we try to outline the most important issues to be included in the education curriculum, what do you think are most important? Why?
- What food-related skills do you think students need to develop?

7.3.3. Data analysis

English translations of the interview transcripts were uploaded to NVivo (QSR NVivo 10) for analysis and were subsequently coded. The constant comparative method was used to identify emerging themes (Charmaz, 2006). In this study, the “step by step” strategy for constant comparative method was used (Boeije, 2002). The first three steps of this approach relevant to our study data included:

- 1) comparison within one interview to develop categories and to label them with suitable codes
- 2) comparison between interviews that belong to the identical group of experts who share quite similar experience (e.g. group of nutritionists, group of food scientists)
- 3) comparison between interviews from different groups to develop and deepen the information and “complete the picture” (Boeije, 2002).

The coding was undertaken by two of the authors in an iterative manner and some manual coding also was undertaken as measures to confirm reliability of the coding process.

7.4. Results

7.4.1. Sample characteristics

The final list of participants, N=28, included five public health nutritionists, five nutritionists, five dietitians, four food scientists, two environmental scientists, two veterinary physicians, one agriculture scientist and four high school teachers (one health teacher, one home economics’ teacher, one agriculture science teacher and one food science teacher) from Tehran, Fars, Isfahan and Gilan, Iran. They were all experienced in food-related education programs and/or food-related policymaking and/or active in food-related research programs.

There were similarities amongst the findings within the same group of experts (e.g. environmental scientists, food scientists). Interviewing a range of food-related experts provided multiple perspectives on nutrition and food systems

knowledge and overcame the potential limitation of interview data reporting selective issues reflecting the views of one or two discipline areas.

Participants believed nutrition and food systems knowledge was necessary for Iranian school-leavers because food-related issues were embedded within people's daily lives. They highlighted the need for a strategic, coherent, continuous and long-term teaching program from the earliest stages within the formal education system until school-leaving age. Other significant issues raised by almost all the participants was the need to focus on food knowledge issues helpful for "routine life" or information for "everyday use" and "practical skills", and the importance of avoiding "professional" and "technical" (science-based) information in education programs.

7.4.2. Important areas of nutrition and food systems knowledge

Five major nutrition and food systems knowledge issue clusters and several sub-clusters were identified, as depicted in Fig. 7.1. The major knowledge clusters were nutrition basics, food production, every day food-related practices, prevalent nutrition-related health problems in Iran, and ethical attitudes in the food domain. These clusters are presented in the following sections.

Major Clusters:

Sub-clusters:

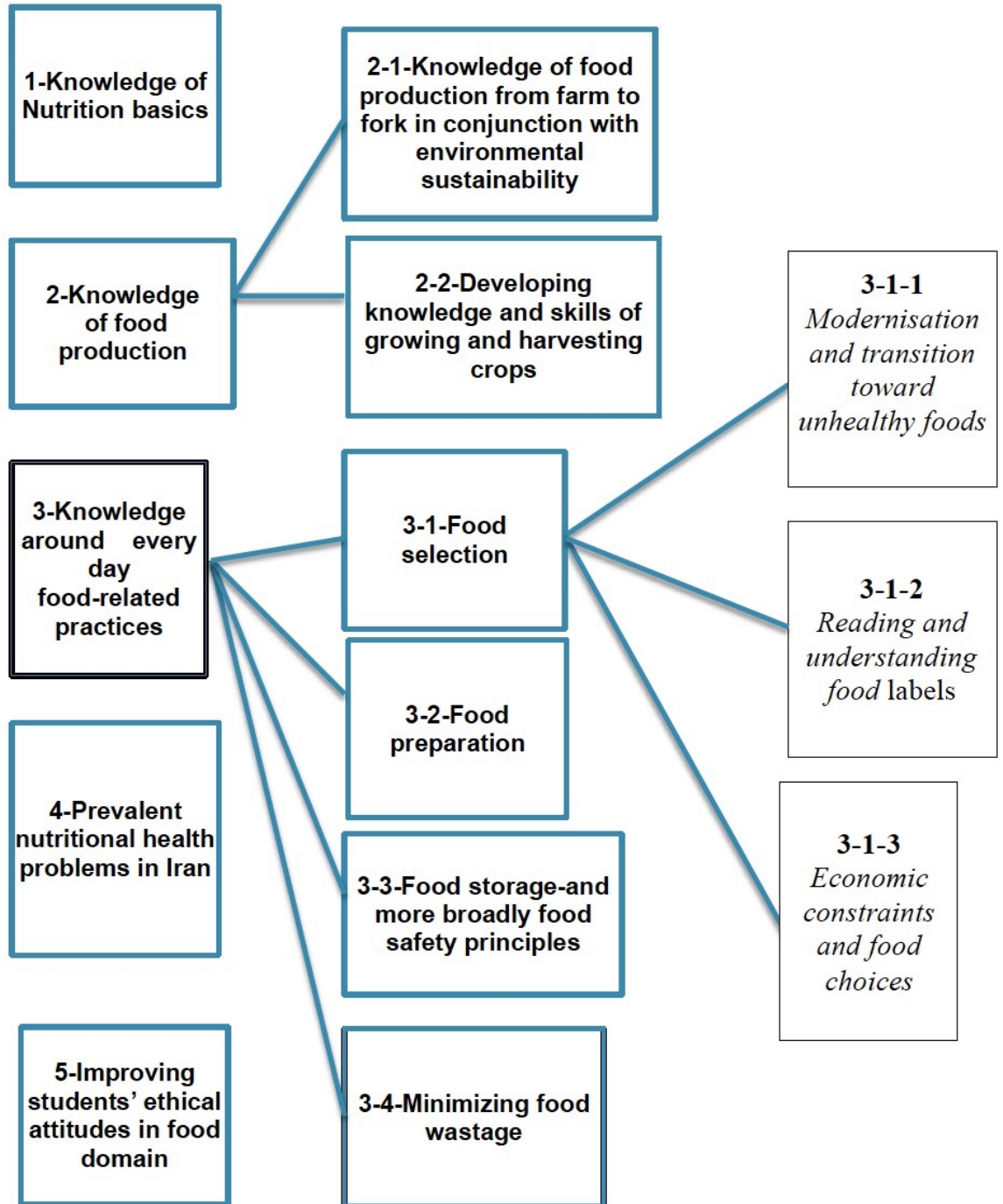


Figure 7.1 Respondents' views of important nutrition and food systems knowledge issues for Iranian school-leavers

7.4.2.1. Knowledge of nutrition basics

This aspect of knowledge, mentioned by most of the participants, included key nutrition recommendations within the national policy guidelines, including the Dietary Guidelines, Food Pyramid and Thrifty Food Basket designed for Iranians. The major focus was on knowledge of the five food groups; nutritious alternatives within each food group; keeping diversity and balance in consumption of foods from all major food groups, and daily consumption of breakfast. It was important to acknowledge and be familiar with the nutrition needs of high-risk population groups, particularly pregnant women, breastfeeding women and children under five, mainly in the context that “future school-leavers might one day become “pregnant” or “a parent”.

7.4.2.2. Knowledge of food production

It was important to know “where foods come from” and “how foods are produced and provided”. Major focuses were on:

- 1) food production from farm to fork in conjunction with environmental sustainability
- 2) knowledge and skills for growing crops.

Food production from farm to fork in conjunction with environmental sustainability

Participants raised the need for awareness of food production procedures in relation to different food groups (e.g. dairy products and cereal foods) from farm to fork. At the same time, they raised the need to avoid “unnecessary”, “theoretical”, “technical” and “professional” information.

For example, school-leavers need to be familiar with milking cows in livestock farm, ways of storing milk, transporting milk to the factory, pasteurising milk, and producing yogurt, cheese, etc., also transferring the products to the market and issues around milk adulteration like adding water or starch to it. (10-R)

Environmental scientists and some public health nutritionists emphasized knowledge of the negative effects on the environment of inappropriate food production systems. Three issues were identified. Firstly, the significant use of natural resources for producing animal-based proteins compared to plant foods. Secondly, the negative effects of inappropriate agricultural practices on the environment through inappropriate management and use of chemical fertilizers and pesticides. Thirdly, they raised the harmful environmental effects caused by intensive livestock production systems, including increasing greenhouse gas emissions and overuse and damage to natural resources.

We should highlight the importance of protecting our environment because school-leavers should not only care about what they eat but also about the environment that we are living in – the land, soil, and air. (8-M)

Developing knowledge and skills of growing and harvesting crops

A few participants believed students and school leavers, particularly rural students, needed some knowledge of growing and harvesting. They asserted that equipping students with this knowledge might positively affect their attitudes, knowledge, and skills regarding gardening and farm-related occupations.

In Iran, we have proper agricultural lands and it is needed to add agriculture topics within school curriculum ... Then they might find enough self-esteem to start farm-related jobs. (11-SH)

7.4.2.3. Knowledge around everyday food practices

Each of the study participants mentioned a few knowledge issues related to everyday food practices, including knowledge of food selection, food preparation, food storage (more broadly food safety), and minimizing food wastage.

It is very important for school-leavers to have some knowledge about food labeling, food storage, and food preparation and cooking. (19-J)

We haven't done considerable work on food selection knowledge domain in our country, not for adults, nor for kids. This is a gap in Iran and we need to work on it. (18-A)

Food selection

The focuses of knowledge for food selection were on:

- 1) modernization and food transition toward unhealthy foods
- 2) reading and understanding food labels
- 3) economic constraints and food choices.

Modernization and food transition toward unhealthy foods

Participants raised the significant role of globalization and modernization in transition toward the consumption of “tasty” and “convenient” foods. This was particularly important as they expressed the view that “junk foods”, “highly processed foods”, “fast food” and “take away” was associated with the rising prevalence of nutrition-related health problems in Iran. Participants believed that education programs should provide regular warnings about the disadvantages of these unhealthy foods.

Some participants were of the view that regular education (in conjunction with feeding children with healthy foods from early childhood in the home setting) was likely to influence later healthy food selection behaviors.

In Iran, we have had lots of dramatic changes. These changes have been a sort of modernization. Dietary culture has changed. Lots of people mainly eat out of home. (15-GH)

Reading and understanding food labels

Several participants believed that improvements in food labels were required for various food products. They expressed a view that if people's knowledge were improved, this would increase the demand for healthier products and for the

development of more appropriate food labels for all foods. This would lead to positive influences over food manufacturers and other relevant organizations.

Economic constraints and food choices

The financial constraints on some Iranian families were considered to affect their healthy food choices in a negative way. Budget management tips were suggested to be incorporated into education programs. The identified budget tips included: equipping students with knowledge of accessible and affordable alternatives within each food group to provide their nutritional requirements; encouraging students to buy seasonal foods (e.g. for fruits and vegetables); and informing students about equivalent nutritional values of some cheap foods versus similar expensive products (e.g. a cheap small apple is similar to a large expensive apple).

We always say do not eat fast foods and eat healthy foods. However, some factors are important in this area like economic issues. For example, fast foods, take away foods and some pre-prepared foods are cheap, quick and accessible. Thus in our education and food-related planning, we need to consider these issues. (18-A)

They need to know what are the best choices based on their economic power. (15-Gh)

Food preparation and cooking skills

Some participants (particularly teachers) highlighted the need for the acquisition of cooking skills, as students would soon become independent and need to cook for themselves and/or their family members.

Some experts referred to the positive culture of Iranians cooking foods at home. However, they also identified the need to modify some poor practices (e.g. frying vegetables for a long time, using too much oil and consuming too much rice). They believed that the provision of simple, practical tips for healthy cooking would be helpful, for example poaching, steaming and grilling methods versus deep-frying; cooking meat thoroughly for safety reasons, and limiting salt and oil use.

It is necessary for school-leavers to have some skills of food preparation at home and also healthy methods of traditional cooking. (5-J)

For example, we can mention that a proper simple method for cooking vegetables to keeps their nutrients is steaming. When you are steaming rice, put the vegetables on top of it. (14-S)

Knowledge of food storage and food safety principles

Participants from different specialties believed that to reduce the incidence of foodborne illnesses, it was necessary to improve school-leavers' knowledge of safe food practices during the preparation, cooking, and storage of foods at home. They also noted relevant information specific to the food situation in Iran, including appropriate methods of consuming tinned foods (i.e. boiling tins for 20 min before opening); skills for shopping for safe, non-packed foods like meat and fish; and the need for caution regarding some food products because of overuse of pesticides and other harmful substances in the production of some agricultural products (e.g. phosphate in some vegetables) and animal products (e.g. nitrate in cows' milk). They considered such information would allow young people to make more choices that are informed and enable them to put pressure on producers to meet the food production regulations.

Iranian school-leavers might be involved in food preparation and storage at home and it is important to increase their knowledge of food safety issues to prevent food-borne illnesses. (4-H)

Minimization of food wastage

Everyday food practices also included knowledge and skills for minimizing food wastage at the household and production level. For minimizing food wastage in households some experts mentioned the importance of proper storage, planned shopping and selecting food products with environmental friendly packages.

7.4.2.4. Knowledge of prevalent nutrition problems in Iran

The dietitians, nutritionists, and public health nutritionists focused on education about common nutrition-related health problems in Iran such as overweight, obesity, diabetes, cardiovascular diseases and micronutrient deficiencies (e.g. iron, zinc, vitamin D and vitamin B). Two participants raised the need for informing students about eating disorders (e.g. anorexia and bulimia nervosa), particularly among teenagers and young adults. The participants assumed that awareness about the consequences of prevalent nutrition-related health problems, in conjunction with the provision of nutrition and physical activity recommendations, would be helpful for the prevention and management of such problems.

At present, we are struggling with chronic diseases in Iran and nutrition-related awareness is really crucial. (11-SH)

7.4.2.5. Improving students' ethical attitudes in the food domain

A few participants mentioned ethical attitudes of students in the food domain, particularly in terms of animal welfare and environmental sustainability. These experts highlighted animal welfare issues in livestock production systems (e.g. methods of raising farm animals and the benefits of free-range methods). The participants also highlighted the need for providing insights into the value of reducing consumption of animal-based proteins to fulfill daily nutrition requirements, and the importance of respecting and preserving nature through better management techniques and water and soil use. The ethical importance of minimizing food-related wastage was also raised.

Those who respect nature, creatures, earth, soil and plants and try to preserve the world for the next generations have valuable attitudes. (11-SH)

7.5. Discussion

This study identified a broad range of nutrition and food systems issues that nutrition and food system experts in Iran considered were important for students to learn during schooling. The results collectively present a broad perspective of nutrition and food systems knowledge issues reflective of the NNS framework and its principles (Beauman et al., 2005). The wide range of nutrition and food systems knowledge issues was not unexpected, as broad, open-ended questions were used in the interviews and the participants were experts from a range of fields relating to nutrition and food systems.

Few previous studies have considered broadly based nutrition and food system knowledge. One comprehensive investigation focused on food literacy and its components, however ethical dimensions within the food domain, such as environmental sustainability and animal welfare, were not considered (Vidgen and Gallegos, 2014). Of the food knowledge areas identified in this study, three have been consistently reported previously and two less frequently discussed in food and nutrition knowledge literature.

Knowledge of nutrition basics, particularly with reference to national policy guidelines, has been identified in previous studies (Croll et al., 2001; Kandiah et al., 2005; Kothe and Mullan, 2011). This focus reflects many of the participants' attitudes toward the important roles of food-based dietary guidelines for Iranian population groups that take into consideration lifestyle changes, socio-economic situations and nutritional transition issues, which have led to increases in the prevalence of chronic diseases and micronutrient deficiencies (Safavi et al., 2007).

The expressed need for "knowledge about everyday food-related practices" is consistent with the findings in other studies. Previous literature has identified reading and understanding food labels (Sharf et al., 2012), developing cooking skills (Hartmann et al., 2013), and knowledge of food safety issues (Kennedy et al., 2005) as important areas of knowledge. An additional issue raised in this study was the importance of knowledge about nutrition transition issues,

including consumption of junk foods, fast foods, highly processed foods and take away foods, and the need for cautioning students about their potential harms. The existence of nutrition transition issues have been reported in the literature since 1970s (Popkin et al., 2012) and reported in Iran (Ghassemi et al., 2002) but it has not previously been highlighted as an important aspect of knowledge to include in school curricula.

The need for school students to have knowledge of prevalent nutrition-related health problems in Iran, in conjunction with nutrition-related recommendations for prevention and management of chronic diseases, were also reported in this study. This is consistent with previous work which refers to nutrition knowledge as an essential element of health literacy (Spronk et al., 2014).

This study identified two areas of food knowledge, raised less frequently in the food and nutrition knowledge literature. One area was 'knowledge of food production' with a focus on environmental sustainability. While research on sustainable food systems has been reported (Renting et al., 2003; McCarthy, 2014), only a few studies have explored the knowledge required of food production or of food systems more broadly. One previous study surveyed high school students in the United States to assess their knowledge, attitudes, and experiences of the food system. A high level of detail of food systems content knowledge was explored in that study (Harmon and Maretzki, 2006b), as it was the main focus of the study. A lesser focus on food system knowledge in the current study may reflect Iranian experts' lower expectations of students' awareness of food systems, their preference for only teaching the basics of food production systems or that food system knowledge was being explored within a more broadly based discussion.

In the food production, knowledge area the need for developing skills in growing and harvesting crops was identified. This was mainly aimed at the improvement of students' skills relating to, and attitudes towards, farm-related jobs. This is different to previous studies, where food production knowledge issues were focused more on gardening education programs to improve dietary behaviors such as fruit and vegetable intakes (Lautenschlager and Smith, 2007).

Enhancement of school leavers' ethical attitudes in the food domain, particularly in terms of environmental sustainability issues in relation to food production systems and animal welfare, has been reported least frequently in previous food knowledge literature. Consumers, policymakers and producers around the world had become more mindful of farm-animal welfare (Heng et al., 2013). Other literature discusses the influences of consumers' food choices or impacts of food production systems on climate change and the environment (Carlsson-Kanyama, 1998). The current study identified the importance of ethical food-related issues that enable school-leavers to make value-based food choices.

Study findings were analyzed using the multidimensional framework for knowledge and learning (Yang, 2003). The range of areas of knowledge identified by the participants reflected all three facets of knowledge including explicit (e.g. recommendations in policy guides), implicit (e.g. cooking skills and growing and harvesting crops) and emancipatory (animal welfare and environmental sustainability). However, the major foci of the participants' responses were on knowledge of practical issues, information for everyday use and developing practical skills. Thus by considering Yang's epistemology of knowledge, overall the participants had greater focus on implicit knowledge (practice) and those specific parts of explicit knowledge (scientific principles) that could directly affect implicit knowledge. Only a few of the participants highlighted the critical role of value-based issues (emancipatory knowledge) in food education programs.

Utilization of Yang's knowledge framework in this study provides a broader understanding of nutrition and food-related topics in education programs. Adoption of such theoretical frameworks is not common in the food and nutrition knowledge domain. This may be one reason why the multidisciplinary nature of food and nutrition science has not strongly reflected in education programs to date.

7.6. Conclusion

Findings of the current study provide a guide to curriculum developers and policy makers to assess current education curricula in order to optimize students' knowledge of nutrition and food systems.

Ethical considerations: Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

7.7. Acknowledgements

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Chapter 8: Iranian study, part 2

This chapter refers to the second part of Iranian study. It reveals the perspectives of 26 Iranian food professionals regarding Iranian school-leavers' knowledge of nutrition and food systems (N&FS). It answers the questions:

- 1) What aspects of nutrition and food systems knowledge are school-leavers are well informed about? Why is their knowledge good in these areas?
- 2) What aspects of nutrition and food system knowledge are school-leavers not well informed about? Why is their knowledge poor in these areas?

This chapter identifies Iranian professionals' perceptions of the strengths and weaknesses of Iranian school-leavers' N&FS knowledge and factors that affect school-leavers' knowledge.

It is notable that, although 28 food professionals participated in the first and third parts of the Iranian study, two of the participants expressed that they were not well aware of Iranian school-leavers' knowledge of N&FS.

This chapter was submitted as a short research paper to the *Iranian Journal of Public Health* and was accepted and published as a letter to the editor (see Appendix 5) in the course of this PhD degree. It is presented here with minimal modifications to formatting, related to referencing style and page layout, to create a cohesive document and to follow the University of Wollongong's recommended referencing style.

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Author's contribution: This study was designed by Sanaz Sadegholvad, Heather Yeatman, Nasrin Omidvar, Anne-Maree Parrish and Anthony Worsley. All interviews were conducted by Sanaz Sadegholvad. Sanaz Sadegholvad collected and analysed the data, and Nasrin Omidvar supervised different stages of the data collection and Heather Yeatman supervised the data analysis. Sanaz Sadegholvad

developed the first manuscript, and the other authors reviewed and improved final manuscript.

8.1. Abstract

Background: There is a scarcity of literature exploring Iranian people's knowledge of a wide range of nutrition and food systems issues. This study aimed to explore food experts' views of gaps in Iranian school-leavers' current knowledge of nutrition and food systems.

Method: Twenty-six experienced Iranian food-related experts were interviewed (face-to-face or through telephone). Experts were selected from Tehran, Shiraz, Isfahan and Gilan provinces. Thematic analysis approach was employed to analyze and interpret the qualitative data.

Results: Study participants expressed their views on key determinants of nutrition and food systems knowledge among Iranian school-leavers including the content of school books, attractiveness of food and nutrition topics for students, students' geographical location, family environment, mass media and duration of education programs provided for students. Overall, experts reported Iranian school-leavers had poor knowledge of various food and nutrition issues, even those addressing primary nutrition issues (e.g. nutrition in conjunction with malnutrition). The most commonly agreed area of limited knowledge was related to food systems (e.g. knowledge of food production, food processing and food impacts on the environment).

Conclusion: The results of this study will inform the identification of neglected components of nutrition and food systems education within school curricula. More broadly findings could assist food and nutrition educators, curriculum developers and related policy makers to improve current nutrition and food systems education programs in schools in Iran.

Key Words: knowledge, nutrition, food systems, school-leavers and Iran

8.2. Introduction

A few years ago Iranian researchers reported that health care policies in Iran have mainly focussed on prevention and treatment of infectious diseases and

there is less attention toward chronic diseases (Sepanlou et al., 2010). However, in 2002, the World Health Organization reported that 70% of all deaths in Iran were related to chronic diseases (World Health Organisation [WHO], 2002). In addition, more than one decade ago, Iranian literature raised concerns about the increased prevalence of chronic diseases (Ghassemi et al., 2002). The major reasons were reported as dietary transition toward a higher consumption of unhealthy foods and decrease in physical activity associated with increasing urbanization of the population (Ghassemi et al., 2002). In this area, a large number of Iranian investigators highlighted the important role of nutrition in prevention and management of chronic diseases such as overweight and obesity (Malekzadeh et al., 2005), diabetes (Sharifirad et al., 2009), cardiovascular diseases (Tavassoli et al., 2015a) and cancer (Salehi et al., 2010). A shared recommendation of these investigators was knowledge development, and the provision of relevant nutrition education programs. Development of these studies in Iran was in conjunction with increase in investigations that assessed Iranians' knowledge of particular aspects of nutrition for better health outcomes. For example knowledge of food groups (Ahadi et al., 2014), food safety issues (Askarian et al., 2004), reading and understanding food labels (Ahmadi et al., 2013) and balanced diet plans (Mirmiran et al., 2007; Azizi et al., 2010; Fallah et al., 2013).

This pattern of research on assessment of knowledge in relation to the specific aspect of nutrition is moderately similar at the level of worldwide. For example studies report on knowledge of food labels to facilitate use of label information to select healthier foods (EunSeok et al., 2014; Liu et al., 2015); knowledge of food safety for 'safe food handling practices and habits' to reduce the incidences of food borne illnesses' (Green and Knechtges, 2015); cooking skills and their potential effects on healthy eating and weight management (Reicks et al., 2014); and knowledge of dietary recommendations to adopt healthy dietary behavior (Milosavljević et al., 2015). These researchers also concluded their studies by highlighting the importance of providing food and nutrition related education and/or improving knowledge of the issues they have investigated.

Globally, in the food knowledge assessment domain, apart from those studies that primarily focused on knowledge of health-related aspects of nutrition, only few studies like a study by Harmon and Maretzki (2006d) focused on knowledge of food systems more broadly (e.g. sustainability, agriculture and food origins) (Harmon and Maretzki, 2006B). Raising awareness in relation to the sustainability of food systems is recommended and targeted by United Nations to “accelerate the shift toward sustainable food systems”, which is supportive of food security (United Nations Environment Programme, 2016). A focused area of knowledge by United Nations is increasing awareness about adoption of more sustainable diets (United Nations Environment Programme, 2016). Some nutrition literature also focused on the importance of ecologically sustainable diets that are at the same time supportive of health and environmental sustainability (PHAA, 2015a; Ruini et al., 2015). Literature reported that it is necessary to increase people’s awareness regarding the nutritional and environmental impacts of their food choices (Ruini et al., 2015).

Iranian studies have not addressed the importance of food systems knowledge and relevant education programs for Iranian communities. In addition, here is not any available study revealing Iranians’ knowledge of food systems issues. Previous Iranian studies have focused on measuring knowledge of specific aspects of nutrition associated with people’s health and wellbeing (e.g. Askarian et al., 2004; Mirmiran et al., 2007; Ahmadi et al., 2013; Ahadi et al., 2014), but have omitted to explore knowledge of nutrition and food systems more broadly. This study aimed to assess experts’ views of the current knowledge of Iranian school-leavers about nutrition and food systems issues in a broader context.

8.3. Method

8.3.1. Study sample and recruitment

To address a wide range of nutrition and food systems issues, the investigators of this study aimed to interview a wide range of food-related experts from academia, government and non-government organisations, and from the private

sector. The aim was to include participants from nutritionists, public health nutritionists, dietitians, food scientists, environmental scientists, veterinary physicians, agriculture scientists and schools' health teachers. Experts were recruited through purposive sampling and snowballing methods. The participants were invited by email or in person or by telephone. Information sheets, consent forms and interview questions were sent via email to the interviewees prior to the interview. All documents were provided in Farsi (native language of Iran).

8.3.1.1. Study design

Face-to-face or telephone interviews were performed between September and December 2012. Open-ended questions explored experts' perceptions of Iranian school-leavers' current nutrition and food systems knowledge. The study authors designed the interview questions. The first author, for whom Farsi is her first language, conducted all interviews in Farsi. Interviews ended when data saturation was achieved. The interviews were recorded and transcribed in Farsi and afterwards translated into English (by the first author). The interview questions (translated from Farsi to English) were:

- 1) What aspects of nutrition and food systems knowledge do you think school-leavers are well informed about? Why do you think their knowledge is good in these areas?
- 2) What aspects of nutrition and food system knowledge do you think school-leavers are not well informed about? Why do you think their knowledge is poor in these areas?

8.3.1.2. Data analysis

Initially, translated interviews from Farsi to English were uploaded to Nvivo software to perform the data analysis. Thematic analysis approach, a commonly used method for analyzing qualitative data (Vaismoradi et al., 2013) was employed. Transcripts were read several times to get familiar with the data (Vaismoradi et al., 2013). Initial codes were generated across the whole data set (Vaismoradi et al., 2013). Then potential themes were developed and reviewed

to generate a thematic map (Vaismoradi et al., 2013). Finally, after “defining and naming themes”, a report of the results was developed (Vaismoradi et al., 2013).

8.3.2. Results

Twenty-six experienced food-related experts from Tehran, Shiraz, Isfahan and Gilan provinces were interviewed including; five nutritionists, five public health nutritionists, five dietitians, four food scientists, two environmental scientists, one veterinary physicians (who were knowledgeable in animal-based food production system) and four high school teachers (who were experienced in teaching food-related topics at schools).

These 26 participants were regularly in contact with young Iranians or were active in food-related issues associated with young adults. Their connections with young population groups were mainly through: teaching food related programs at universities and schools; conducting different food-related programs such as speeches at schools; involvements as food educators in governmental and non-governmental organizations; or through their involvement in food knowledge research projects.

Several themes were generated from the interview transcripts in relation to the current knowledge of Iranian school-leavers in regard to nutrition and food systems issues. They included: general poor and scattered knowledge across most of the nutrition and food systems areas; lack of specific knowledge of food systems; knowledge and attractiveness of nutrition and food systems topics to students; common determinants of nutrition and food systems knowledge; and barriers to students' study of nutrition and food systems at the school level.

8.3.2.1. Poor, and scattered knowledge across most of the nutrition and food systems areas generally

Almost all of the study participants believed that school-leavers have very limited knowledge of nutrition and food systems topics. Some believed that school-leavers are not aware of some fundamental nutrition issues such as

appropriate nutrition for growth and development; malnutrition; food and chronic diseases; food borne-illnesses and other food safety issues.

I think school-leavers' knowledge is very scattered, unstructured and periodic. (19-J)

Their knowledge is very limited in many areas such as nutrition in relation to chronic and infectious diseases or food poisoning. Indeed, teenagers don't think about these issues. (10-R)

8.3.2.2. Lack of specific knowledge of food systems

Most of the participants mentioned that students' knowledge of food systems is substantially lacking in relation to agriculture, food production, food processing and environmental issues associated with food systems. The major reason for this knowledge deficit was identified as a lack of attention to food systems topics within schools' education curricula and general societal education (e.g. through mass media).

In relation to foods and environmental issues both kids and adults have very poor knowledge. (17-D) .

I think school-leavers have less knowledge and less interests about growing, harvesting, and processing foods. It is not important for them whether this orange is produced in Iran or Lebanon. (25-S)

8.3.2.3. Knowledge and attractiveness of nutrition and food systems topics to students

Some experts believed that school-leavers have some knowledge about topics that are appealing to them, particularly those that are related to their physical appearance (e.g. weight issues), and physical activity and sport performance. However, some experts expressed their concerns about the accuracy of students' and school-leavers' knowledge of these issues, due to the unreliability of their information sources, for example gymnasiums.

As I know ... both boys and girls look for appearance related issues. Some also show interests in nutrition associated with physical activity and sport, but the important point is that how accurate is their received information. (5-J)

8.3.3. Determinants of current nutrition and food systems knowledge among Iranian school-leavers

The participants reported key determinants of nutrition and food systems knowledge that they believe have positively or negatively affected the current food knowledge of school-leavers. These included: the content of school textbooks; the attractiveness of food and nutrition topics for students; students' geographical location (urban or rural); the family environment (parents' occupation, for example farmer or office worker, and parents' own knowledge and practices of nutrition and food systems); mass media activities; and duration of food and nutrition education programs provided for students. Overall, the participants believed that at present Iranian schools and mass media do not use their potentials to deliver important nutrition and food systems information to Iranian population groups.

Rural kids are more familiar with nature, wildlife, growing and harvesting crops, and raising cattle and poultries. However urban kids are usually unfamiliar with these sorts of issues. (17-D)

Nutrition education programs in Iran have been diluted and non-concentrated. There have been some thoughts and plans in this area, but they have not always been described and followed properly. This is a very important issue. (20-V)

8.3.2.1. Key barriers to students' study of nutrition and food systems at the school level

The participants stated that food and nutrition information included in school textbooks was inadequate and mostly not useful for everyday living.

Students in Iran study some theoretical lessons and memorize them for exam and then after a while they forget most of them ... and most of these topics are not practical at all. (9-M)

Another key issue identified was related to the major areas of study taken by students at schools. Based on the formal education system in Iran, students in high schools need to select a particular major to continue their education. Students studying in the science stream receive some food-related lessons, however those studying in social sciences, mathematics and other majors were not likely to receive any nutrition and food systems education.

Usually students who are studying in science stream have better nutrition knowledge because they study some related topics in their biology textbook. However, art, mathematic and social sciences students have much less knowledge in these areas. It is much better to allocate a book or something for them. I don't think any nutrition-related material is provided for them. (12-T)

8.4. Discussion

This study explored experienced food experts' views of Iranian school-leavers' knowledge of nutrition and food systems. Study participants shared the view that overall school-leavers lacked knowledge of most nutrition and food systems issues that might reflect insufficient or inefficient nutrition and food systems education programs in Iranian schools. It is not very unexpected as studies related to different countries reported that nutrition education provided for students at schools appears to be inadequate (Pérez-Rodrigo and Aranceta, 2003; Kazemian et al., 2014; Carraway-Stage et al., 2015).

To the best of our knowledge, previous Iranian literature has not directly assessed students' and school-leavers' knowledge of identified important nutrition issues such as; nutrition for growth and development, nutrition in conjunction with malnutrition, food and chronic diseases, and food safety issues and food borne-illnesses. However, knowledge deficiencies in relation to some of the important nutrition issues identified in this study, has been reported among

other Iranian population groups. For example, a study of food safety knowledge, among 266 women in one Iranian city showed that 63.2% of the participants lacked knowledge about the safety of refrigerated cooked foods. 41.4% had wrong attitudes about cleaning fruit and vegetable and believed that just a minimal cleaning of fruits and vegetables make them safe enough for consumption (Hajimohammadi et al., 2014). Interviewed experts in this study reported that school-leavers lacked knowledge of growth and development, and highlighted knowledge shortage in relation to malnutrition. Recent Iranian literature had reported 9.35% of stunting (chronic malnutrition) among children under six in a major province of Iran (Fars) and identified low maternal education as a key determinants of this problem (Kavosi et al., 2014). In contrast to identified knowledge deficiencies in relation to some of the important nutrition issues in this study and other current Iranian studies (Hajimohammadi et al., 2014; Kavosi et al., 2014), some Iranian literature identified moderate to good level of knowledge regarding other aspects of nutrition such as households' awareness of food groups (Ahadi et al., 2014) and mothers' knowledge of supplementary nutrition (Mohammadhossini et al., 2014). Further research is required to assess the knowledge levels of different population groups of Iranians regarding a wide range of important nutrition issues.

This study identified that experts perceived there were substantial knowledge gaps in the area of food systems. Overall, there is absence of literature exploring Iranian populations' knowledge of food systems issues in relation to food systems sectors, food production, food processing, agriculture and environmental sustainability. This might reflect national lack of attention to the importance of food systems knowledge issues at different levels of education. The situation in Iran is reflected in other countries. Indeed, very limited food knowledge literature, such as "a survey of food system knowledge, attitudes, and experiences among high school students" by Harmon and Maretzki (Harmon and Maretzki, 2006d) has explored knowledge of a wide range of food systems issues such as food system sectors, food origins, sustainability, local foods, agriculture, food safety, and hunger (Harmon and Maretzki, 2006d). However the importance of knowledge about particular aspects of food systems is highlighted in

International literature. For example awareness of farm animal welfare issue related to food production systems is recommended to make more informed food choices (Jamieson et al., 2015), knowledge of agriculture is highlighted to “support policies for the establishment and maintenance of viable agriculture systems” (Worsley et al., 2015d: p.408) and increasing knowledge of sustainable food systems in relation to adoption of sustainable diets is targeted by United Nations’ Sustainable Food Systems Programme, to support food security (United Nations Environment Programme, 2016)

In this investigation, some of the participants suspected the information sources students use regarding their favourite nutrition topics (e.g. weight loss) were unreliable. A Canadian study (Ostry et al., 2008) identified high use of commercial websites (80% of visits) among the public to search health and nutrition information, which might offer inappropriate messages. However non-commercial governmental website provided the best advice (Ostry et al., 2008), International literature also raised concerns on poor quality of some information provided to young population groups. For example a study of the nutrition knowledge and dietary recommendations by coaches to Brazilian adolescent athletes found that coaches recommended dietary practices such as very low-fat diets; an over emphasise on proteins; and perpetuated food myths (Juzwiak and Ancona-Lopez, 2004). Future research could explore what Iranian students would like to learn about nutrition and food systems and also examine the accuracy of commonly accessed information sources.

This study suggested several determinants of nutrition and food systems knowledge among Iranian school-leavers including: contents of schoolbooks, attractiveness of food and nutrition topics for students, students’ geographical location, family environment, mass media activities, and duration of provided food and nutrition education programs. The participants’ identification of insufficient nutrition information in schoolbooks is consistent with a recent Iranian study that concluded the potential of primary school textbooks to deliver health-related messages (e.g. nutrition) has not been fully utilised (Kazemian et al., 2014).

These findings differ from the common determinants of nutrition knowledge reported in existing literature, which include educational level, age of students and family occupation (Hendrie et al., 2008a; De Vriendt et al., 2009). Such differences may have arisen because most of the previous studies focused on nutrition knowledge alone, whereas in the present study knowledge of nutrition issues was explored in conjunction with knowledge of food systems. Additionally, previous studies did not explore experts' views on this matter. Experts are likely to take a wider perspective of influences on knowledge acquisition than the limited demographic indicators usually reported in quantitative surveys of knowledge.

8.4.1. Acknowledgements

The authors appreciate the Iranian experts' kind cooperation who participated in this study.

8.4.2. Conclusions

This study presented experts' views of Iranian school-leavers' gaps in nutrition and food systems knowledge. The experts also identified some determinants of school-leavers' nutrition and food systems knowledge, together with barriers to students' study of nutrition and food systems. The experts' perspectives will assist curriculum developers to identify neglected components within nutrition and food systems education programs and enable policy makers to improve current nutrition and food systems education programs in schools of Iran.

8.5. Letter to the editor

This section of chapter 8 presents a letter to the editor, which was published in the *Iranian Journal of Public Health*. The letter describes Iranian food professionals' perceptions regarding Iranian school-leavers' knowledge of N&FS.

Publication title: Gaps in Iranian school-leavers' current knowledge of nutrition and food systems

Dear Editor-in-Chief

There is a scarcity of literature exploring Iranian people's knowledge of a wide range of nutrition and food system (N&FS) issues. Twenty-six experienced Iranian food-related experts from different provinces of Iran (Fars, Tehran, Isfahan and Gilan) were interviewed between September 2012 and December 2012 to explore their views of gaps in Iranian school-leavers' current knowledge of N&FS. Thematic analysis approach was employed to analyze the qualitative data. Five key themes emerged from interview transcripts, briefly described here:

1) Generally poor, and scattered knowledge across most of the N&FS areas; even those related to fundamental nutrition issues such as appropriate nutrition for growth and development; malnutrition; food and chronic diseases; foodborne illnesses and other food safety issues reported by most of the participants. Previous Iranian literature has not directly assessed students' and school-leavers' knowledge of identified fundamental nutrition issues.

2) Substantial lack of specific knowledge of food systems; in relation to agriculture, food production, food processing and environmental issues associated with food systems. The major reason for this knowledge deficit was identified as a lack of attention to food systems topics within schools' education curricula and general societal education (e.g. through mass media). There is absence of literature exploring Iranian populations' knowledge of food systems issues. However, the importance of food systems knowledge has been reported in international literature as "our food choices not only affect our health, but they can also have wide-

ranging implications for the sustainability of food production and natural resources” (Harmon and Maretzki, 2006b).

3) Knowledge and attractiveness of nutrition and food systems topics to students; school-leavers have some knowledge about topics that are appealing to them, particularly those related to their physical appearance (e.g. weight issues), and physical activity and sports performance. However, experts expressed their concerns about the accuracy of students’ and school-leavers’ knowledge of these issues, due to the unreliability of their information sources, for example, gymnasiums. International literature also has raised concerns about poor quality of some information provided to young population groups. A Brazilian study of the nutrition knowledge and dietary recommendations by coaches to adolescent athletes found that coaches recommended dietary practices such as very low-fat diets; over emphasize on proteins, and perpetuated food myths (Juzwiak and Ancona-Lopez, 2004).

4) Determinants of current N&FS knowledge, that positively or negatively affected the current N&FS knowledge of Iranian school-leavers. These included the content of school textbooks; the attractiveness of food and nutrition topics for students; students’ geographical location (urban or rural); the family environment (parent’s occupation, for example farmer or office worker, and parents’ own knowledge and practices of nutrition and food systems); mass media activities; and duration of food and nutrition education programs provided for students. Overall, the participants believed that at present Iranian schools and mass media do not use their potentials to deliver important nutrition and food systems information to Iranian population groups. The participants’ identification of insufficient nutrition information in schoolbooks is consistent with a recent Iranian study that concluded the potential of primary school textbooks to deliver health-related messages (e.g. nutrition) has not been fully utilized (Kazemian et al., 2014). These findings differ from the common determinants of nutrition knowledge reported in existing worldwide literature, which includes educational level, age of students and family occupation (Hendrie et al., 2008a; De Vriendt et al., 2009). Such differences may have arisen because most of the previous studies

focused on nutrition knowledge alone, whereas in the present study knowledge of nutrition issues were explored in conjunction with knowledge of food systems. Additionally, previous studies did not explore experts' views on this matter. Experts are likely to take a wider perspective of influences on knowledge acquisition than the limited demographic indicators usually reported in quantitative surveys of knowledge.

5) Key barriers to students' study of N&FS at the school level, including food and nutrition information covered in school textbooks is inadequate and mostly not useful for everyday living; and some major areas of study taken by students at high schools are limiting. Students studying in the science stream receive some food-related lessons; however, those studying in social sciences, mathematics and other majors are likely to be deprived of nutrition and food systems education.

The results of this study are important as they can inform the identification of neglected components of N&FS education within school curricula. More broadly, the findings can assist food and nutrition educators, curriculum developers and related policy makers to improve the current N&FS education programs in schools in Iran. Knowledge is power and better-informed school leavers are more likely to make healthy and sustaining food choices.

8.6 Acknowledgements

The authors thank the participants of this study.

Chapter 9: Iranian study, part 3

This chapter presents the third part of the Iranian study. It answers the following questions:

- 1) What are the best strategies to increase the knowledge of school-leavers in relation to N&FS?
- 2) What could be done differently to increase their knowledge?

This was undertaken through a qualitative investigation of Iranian food professionals' views. This was conducted through semi-structured interviews with 28 Iranian food professionals. Findings indicate the recommendations of Iranian food professionals regarding required strategies to improve Iranian school-leavers' knowledge of N&FS. These findings resulted in development of a scholarly guide for N&FS education purposes for schools in Iran.

This chapter was published in the peer-reviewed *International Journal of Preventive Medicine* (see Appendix 6) in the course of this PhD degree. It is presented here with minimal modifications to formatting, related to referencing style and page layout, to create a cohesive document and to follow the University of Wollongong's recommended referencing style.

Citation: Sadegholvad S, Yeatman H, Omidvar N, et al. (2016) Best strategies to improve school-leavers' knowledge of nutrition and food systems: views from experts in Iran. *International Journal of Preventive Medicine* 7(119): 26–34.

Author's contribution: This study was designed by Sanaz Sadegholvad, Heather Yeatman, Nasrin Omidvar, Anne-Maree Parrish and Anthony Worsley. All interviews were conducted by Sanaz Sadegholvad. Sanaz Sadegholvad collected and analysed the data, and Nasrin Omidvar supervised different stages of the data collection and Heather Yeatman supervised the data analysis. Sanaz Sadegholvad developed the first manuscript, and the other authors reviewed and improved the manuscript.

9.1. Abstract

Background: The research to date does not present an articulated approach to ensure nutrition and food system education is systematically implemented within schools. This paper aimed to investigate food experts' views of the best strategies to improve school-leavers' knowledge of nutrition and food systems.

Method: In this qualitative study, twenty-eight Iranian food and nutrition experts from four major provinces (Tehran, Fars, Isfahan and Gilan) were selected and agreed to be interviewed. Required data were collected through indepth, semi-structured, face-to-face or telephone interviews and were analyzed thematically using NVivo .

Results: The experts' suggested strategies to improve Iranian school-leavers' knowledge of nutrition and food systems fell into three key themes: policy, education processes and supportive environments. Together they formed an overarching theme of a continuing, structured education program with multiple methods for transferring knowledge.

Conclusion: Development of a scaffolded education program could assist curriculum developers and policy makers to assess and update current nutrition and food systems education programs in schools. Insights gained about education initiatives in one country such as Iran can provide an important impetus to support nutrition and food system education more widely.

Key Words: nutrition, food systems, knowledge, education strategies, school-leavers, Iran

9.2. Introduction

In the 1970's dietary behavior started to shift toward increased consumption of processed foods, fast foods, takeaway foods, sugary beverages and fats. In the low and middle-income countries, these changes started in the early 1990's, however became clearer when obesity, diabetes and hypertension became more widespread globally (Popkin et al., 2012). Literature also reported that high

consumption of energy-dense food choices, highly processed foods and animal-based products; particularly beef and lamb contribute to environmental degradation and climate change (Friel et al., 2014). Subsequently, the literature increasingly incorporates environmental considerations when discussing dietary and health issues (Friel et al., 2014; Public Health Association of Australia [PHAA], 2015a), such as promoting environmentally sustainable diets, which are at the same time supportive of human health.

The importance of nutrition and food knowledge and the need for relevant education have been widely reported and include: dietary recommendations to adopt healthy dietary behavior (Milosavljević et al., 2015) knowledge of food safety to prevent food born illnesses (Green and Knechtges, 2015) cooking skills to promote healthy eating (Reicks et al., 2014) and the need for knowledge related to reading and understanding food labels to allow more informed food choices (Chopera et al., 2014). However, the research to date does not present an articulated approach to ensure nutrition and food system education is systematically implemented within schools.

Studies have reported the important role of schools in disseminating nutrition information or food related skills to a large proportion of the community (Pérez-Rodrigo and Aranceta, 2003; Macnab et al., 2014). It is reported that “Nutrition education in schools offers a unique opportunity to integrate the teaching of nutrition and the application of that knowledge to achieve a behavior change” (Tab, 1999: 47). However, other studies have identified an underutilization of the potential to transfer important food and nutrition information in the school system (Pérez-Rodrigo and Aranceta, 2003; Kazemian et al., 2014; Carraway-Stage et al., 2015).

Exploration of the best methods to be used by schools to transfer important nutrition-related issues have been reported (World Health Organization [WHO], 1998; Pérez-Rodrigo and Aranceta, 2001). The World Health Organization as a part of ‘Information Series on School Health’ (WHO, 1998), reported that:

... the selection of an educational method should be based on the extent to which that method is appropriate to influence the factors, such as knowledge, attitudes, skills, etc., associated with nutrition-related behaviours and conditions that contribute to health and to the prevention of malnutrition (WHO, 1998, p.19).

This WHO document provides a range of examples of various educational techniques to improve knowledge, increase skills, develop positive attitudes and values and minimize wrong beliefs. Other school-based nutrition education literature also reports on the need to consider a wide range of teaching strategies (Pérez-Rodrigo and Aranceta, 2001).

Complementing these broad approaches are papers that focus on single strategies to improve students' knowledge of nutrition-related issues at schools. For example some researchers have suggested integrating nutrition information with other subjects such as science during schooling (Hovland et al., 2013; Carraway-Stage et al., 2015), and others have recommended increasing nutrition messages within primary school text-books (Kazemian et al., 2014). However, there is a lack of research addressing the broader structural barriers to the implementation of nutrition and food system education in schools. For example do government education policies mandate or even articulate requirements for implementation of nutrition and food system education and how equipped are teachers to implement such education.

Due to universal gap in scholarly literature on effective education frameworks and strategies to develop nutrition and food systems knowledge, this research explored experts' views on strategies to effect improvements in education frameworks to develop nutrition and food systems knowledge. The targeted community in this investigation is Iranian school-leavers. However to explore the generalizability of this guide, findings are compared with two international nutrition education guides and one holistic knowledge theory in relation to and learning. Included nutrition education guides are the World Health Organisation Information Series on School Health (WHO, 1998) and "a logic model framework for community nutrition" (Medeiros et al., 2005). Employed Knowledge

framework (Yang, 2003) address the multifaceted nature of knowledge and defines different features of knowledge in the learning domain. This knowledge framework assists in the assessment of the extent to which the findings are inclusive and multi-dimensional.

9.3. Method

9.3.1. Participants

This study aimed to recruit twenty six Iranian experts from various food-related fields, including four nutritionists, four dietitians, four public health nutritionists, four food scientists, two environmental scientists, two agriculture scientists, two veterinary physicians, and four high school teachers (health and home economics teachers) from major provinces in Iran were invited to participate in the study. Purposive sampling and snowballing methods were employed to recruit a group of acknowledged academics from top ranked universities, experts with major roles in professional governmental and non-governmental organizations and experienced experts from private institutes.

Participants were invited in person or by telephone. Appointments were made for each interview and the participants were issued with the participant information sheet, interview questions, and consent form (all in Farsi) before the interview. Written and/or recorded verbal consents were obtained prior to the interview.

9.3.2. Data collection

Face-to-face or telephone semi-structured interviews with food-related experts were conducted in Iran between September and December 2012. Open-ended interview questions were used to explore experts' attitudes regarding the best strategies to improve Iranian school-leavers knowledge of nutrition and food systems and to investigate their views on current knowledge of Iranian school-leavers of nutrition and food systems. Interview questions were developed by the study authors. The first author, for whom Farsi is her first language, conducted

all interviews in Farsi and recorded them using two digital devices to ensure a backup recording in the case of equipment failure (Marwaha et al., 2010). Interviews were transcribed in Farsi and then translated into English by the first author. Open-ended questions used in interviews with Iranian food experts (translated from Farsi) were:

- What are the best strategies to increase the knowledge of school-leavers in relation to nutrition and food systems?
- What do you think could be done differently to increase their knowledge?

9.3.3. Data analysis

To analyze the qualitative data, the thematic networks' approach (Attride-Stirling, 2001) was applied. First, each interview transcript was read, reviewed and initial codes were noted. Then the whole dataset was coded and reviewed to frame the basic themes ("lowest-order") from the text. Basic themes were then grouped into organizing themes or "middle-order" themes. Finally, organizing themes were grouped into a global theme to summarize the study outcomes in a meaningful way. This technique reflected thematic networks, a tool developed for qualitative analysis (Attride-Stirling, 2001).

9.4. Results

9.4.1 Sample characteristics

To achieve data saturation, the final number of twenty eight food-related experts were interviewed, including; five nutritionists, five dietitians, five public health nutritionists, four food scientists, two environmental scientists, two veterinary physicians, two environmental scientists, one agriculture scientist and four high school teachers (one health teacher, one home economics' teacher, one agriculture science teacher and one food science teacher) from major provinces of Tehran, Fars, Isfahan and Gilan.

Study participants were all experienced in food-related education programs and/or food-related policy making and/ or very active in food-related research fields.

9.4.2. Thematic network reflecting strategies to improve Iranian school-leavers knowledge of nutrition and food systems

The majority of participants when commencing their responses to the interview questions referred to the major problems within current educational programs in schools. They followed these points with their opinions on the best strategies to transfer the required knowledge to students. Identified problems in food and nutrition education programs at schools mainly related to: the high volume of unnecessary theoretical information about nutrition science; the lack of practical and skill-based programs; the limited space in school textbooks for food and nutrition topics; the fact that food and nutrition education is only provided within particular majors at high school (e.g. for Science stream) and not for all majors (e.g. not for Mathematic stream); and the lack of trained teachers who are qualified to teach food and nutrition topics at schools.

The experts' discussions on the best strategies to improve school-leavers' knowledge of nutrition and food systems generated a large number of basic themes. The basic themes incorporate a number of key phrases and terms from the transcripts of different participants all referring to the same issue, and are termed key basic themes in this paper (for example in relation to the key basic theme of "training school teachers" there were several primary themes such as; "teachers require food-related training programs", "we should transfer nutrition and food systems information to our teachers", "teachers might not have adequate knowledge in these areas"). Key basic themes were grouped under three major organizing themes: policy, process of education and supportive environment. These organizing themes shaped the need for a multi-leveled systems approach, presented as the global theme in this paper. Figure 9.1 has summarized these findings.

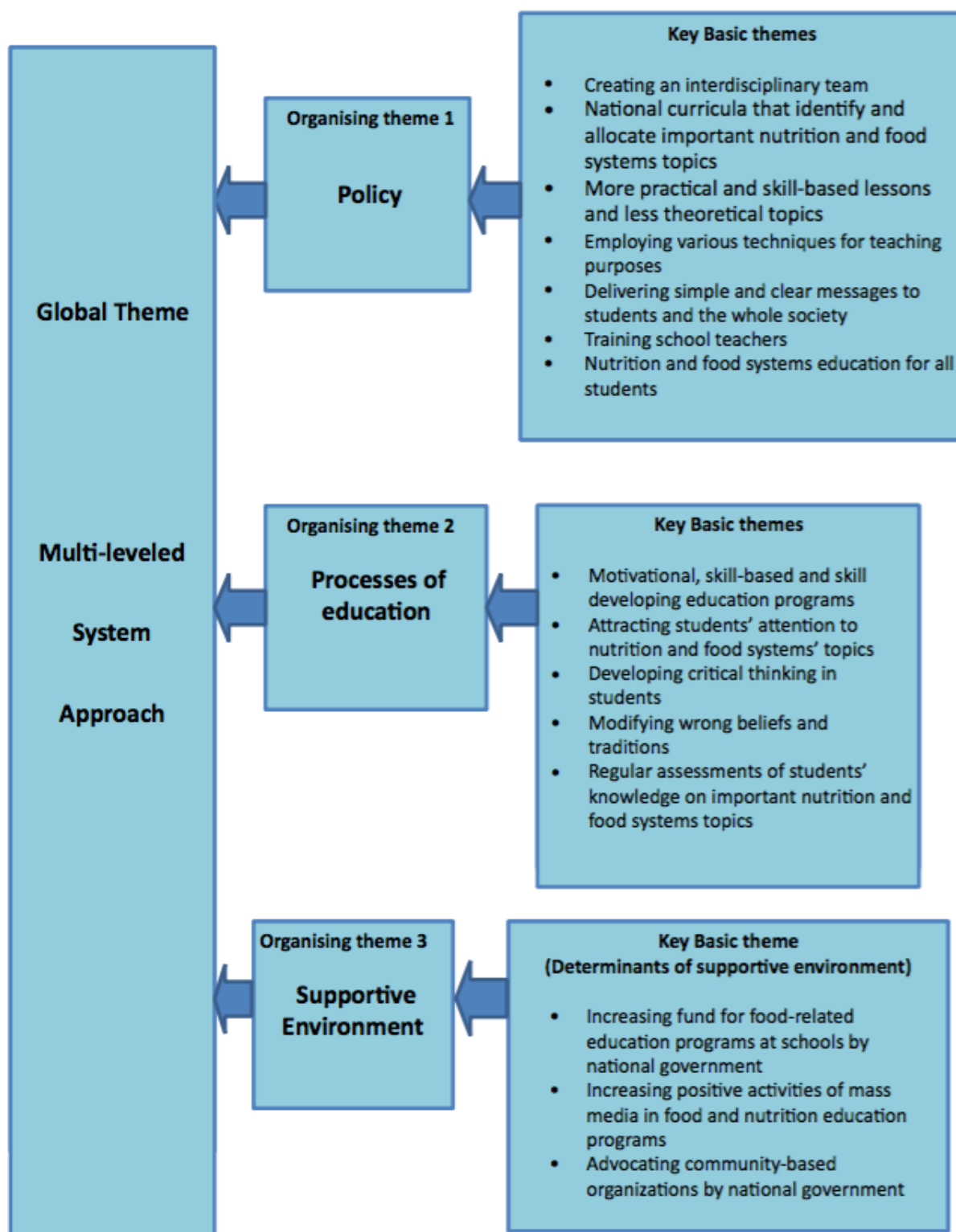


Figure 9.1 Original: Thematic network reflecting strategies to improve Iranian school-leavers' knowledge of nutrition and food systems

9.4.2.1. Global theme: multi-leveled systems approach

Experts raised a large number of issues as essential components of nutrition and food systems education program in schools. Their suggestions were collectively compiled into a multi-leveled framework consisting of three sections or three organizing themes, including policy, process of education and supportive environment.

Organizing theme 1: Policy

Participants reported the need for some inter-and-intra disciplinary improvements in current policies directed to nutrition and food systems education programs in schools, from primary school to high school. Participants referred to the national government as the key creator and director of these policies and highlighted the need for macro-level negotiation with key policy makers who might be influential regarding the implementation of the required actions. Policies that were identified as necessary are shown as key basic themes.

a) Creating an “interdisciplinary team”.

A critical step to improve school-leavers’ knowledge of nutrition and food systems was identified to improve the collaboration between the Ministry of Education, Ministry of Health, food-related experts in various fields, and other food-related governmental and non-governmental organizations. Experts reported the need for an “interdisciplinary team” of acknowledged experts, educators and policy makers across various nutrition and food systems domains who might be influential in improving school-leavers’ knowledge of important nutrition and food systems issues. This was important both in terms of the different disciplines knowing about the perspectives of the other areas and also in order to achieve an agreed, shared outcome.

We need to make an interdisciplinary team ... we cannot handle the whole thing ... Then we need to create a common language. (15-Gh)

Universities and Ministry of Health are not integrated enough with education department (Ministry of Education) ... This collaboration is necessary to improve food and nutrition information within school books. (20-V).

b) National curricula that identify and allocate important nutrition and food systems topics.

Some participants talked about a stepped approach to developing national curricula. Experienced experts from different food-related disciplines first need to identify the important nutrition and food systems topics. Then, because of the “fundamental role of schools in improving the knowledge of people within different societies” (20-V) (3-GH), the Ministry of Education should allocate enough “time” and “space” for these topics within schools’ national curricula. Some experts expressed the view that this education needs to be started from primary school and then continued until graduation from high school. Also highlighted was the need for information to be updated regularly by acknowledged experts within related nutrition and food systems disciplines. This issue was reported in conjunction with the need for regular assessments of students’ nutrition and food systems knowledge to determine their common strengths and weakness for further decision-makings.

It is needed that a group of experts determine what is needed for students from primary school till they get graduated from high school to know about nutrition and more broadly about food. Then these topics should be fitted within schools’ education curricula. (25-S)

c) More practical and skill-based lessons and less theoretical topics.

The majority of participants highlighted the need for a significant decrease in ‘theoretical’ and unnecessary information within school’s educational programs, which were identified as very scientific nutrition information such as “structure of protein and carbohydrate”(#). Participants raised the need for increased focus on topics which were ‘practical’ and allied with people’s ‘every day life’, for example “food groups”, “appropriate alternatives within each food group” and

foods associated with people's health conditions. In addition, the need for offering more skill-based educational programs such as cooking and gardening courses during schooling was reported.

In our schoolbooks the major focus is on theoretical issues ... they are not used in people's routine life ... students just memorize them to get some marks at their exams, just that. (1-A)

Students don't learn enough skills at schools. (11-SH)

d) Integrating nutrition and food systems topics with other subjects

A few participants expressed a preference for a separate food-related subject to be taught in schools. However, most of the experts had the view that a separate subject was unlikely to receive approval from the Ministry of Education. These experts suggested that integrating nutrition and food systems topics within current relevant subjects may be more effective.

The main focus should be on importing these issues into relevant subjects in a very clear and systematic way. (18-A).

e) Employing various techniques for teaching purposes

Almost all study participants referred to limited space within school textbooks to cover all important nutrition and food systems knowledge issues. In order to deal with the lack of space in textbooks, some experts recommended that in conjunction with textbooks, other techniques and tools were required, such as videos, clips, pictures, posters and visiting tours. These educational instruments could be prepared and distributed by the Ministry of Education so as to provide consistent messages and information to a wide range of schools, while others could be developed by schools to reflect their students' unique needs.

Kids are really interested in educational clips ... [and] they really like visiting tours of: various food factories, different stages related to food production, food processing, also growing and harvesting different crops. (23-R & Sh)

Documentaries related to food in conjunction with environmental issues is a good idea. (17-D)

e) Deliver simple and clear messages to students and the whole society

The majority of experts reported that regardless of the sources of nutrition and food systems information provided (e.g. books, media, websites and clips), all messages should be “simple”, “clear” and “easy to understand”. This issue was not limited to students. School teachers and other population groups were also considered to need simple and clear nutrition and food systems information that was useful for everyday life.

We need to simplify the components of our education programs, particularly those that are related to people’s routine life, such as nutrition and food systems issues. (8-M)

f) Training school teachers

Participants reported that schoolteachers are not equipped and updated with nutrition and food systems knowledge issues. Consequently, experts highlighted the need for pre-and in- service education programs for school teachers on important nutrition and food systems topics to enable them to offer accurate and updated information to students.

Our teachers are not really trained in nutrition and food systems. How can they transfer the required information to their students ... We need to arrange training workshops for teachers. (24-Gh)

g) Nutrition and food systems education for all students

Most of the participants reported that at present, students within mathematic, social sciences and some other majors of study do not receive food and nutrition education at schools. They highlighted that nutrition and food systems education should be provided for all students regardless of their education majors.

In summary participants reported the need for implementing several policies covering collaboration between related organizations, revision of schools

education curricula, methods for transferring information, agreed simple concepts, and education for all students and food-related educators at schools.

Organizing theme 2: Process of education

Participants reported the need for running or expanding some interventions and activities at schools which were mainly related to the process of education. .

a) Motivational, skill-based and skill developing education programs.

A large number of reported interventions for nutrition and food systems education programs at schools were suggested, with foci on the education being skill-based, skill developing, motivational and recreational. These suggested interventions were: gardening sessions; cooking classes; healthy food exhibitions; tours of farms and factories; various food-related workshops for students and teachers; setting presentations for students and allocating rewards for best presentations (e.g extra marks for final grade); small food projects for students; and regular speeches on nutrition and food systems issues by food related experts for teachers, students and their parents.

Students can grow some vegetables in pots or boxes at school. Or if they have garden or yards at school, they can grow various crops. (8-M)

Some tours to see different stages of food production ... to a farm to see how wheat grows, then to a factory to see how the flour is produced, after that to a pasta factory. This can be done for dairy products, meat, etc. (4-H)

b) Attracting students' attention to nutrition and food systems topics

The other reported intervention was "attracting students' attention" to the important nutrition and food systems topics. The expert participants made a number of suggestions for attracting students' attention to nutrition and food systems topics that could be grouped in two main ways. One set of techniques for engaging students had a focus on teaching students their favorites topics and using these topics to fit in other relevant important issues (e.g. nutrition in

conjunction with: “fitness”, “sport”, “weight loss”, “weight management”, “beauty” and “intelligence”). The second set of techniques suggested using attractive methods of education, such as visual techniques, for example CDs, clips and tours.

We shouldn't only use books. there are more attractive methods like clips, animations, movies or plays (e.g. videos about osteoporosis) (20-V)

Young boys are looking for foods that make them stronger and more muscular ... girls are interested in food and beauty and weight management issues. (14-M)

c) Developing critical thinking in students

The other reported education intervention was developing critical thinking among students to assist them to broaden their views of various food-related issues. Participants raised the need for: improving research skills in students and allocating more research-based assignments for students; using “question and answer” techniques in education programs; moving beyond food and health topics, for example discussing food and nutrition issues in relation to environmental issues; and further use of visual techniques for food education programs such as pictures and video clips.

To retain students' attention to the lesson and to develop critical thinking among them, teachers can start the lessons with some questions. For example I ask my student what should we eat? While I am modifying their answers I discuss food groups with them. Then I ask them how should those our meals?, how should we prepare our meal? And I will discuss diversity and balance in diet and after that methods of cooking ... it will make them think more actively. (5-J)

d) Modifying beliefs and traditions

Some participants raised concerns relating to the presence of misleading or incorrect information within society that have either been passed on through food-related traditions or through contemporary structures within society (for

example “through gyms”). Several experts expressed that although traditions and culture can have important and constructive roles in some food-related practices (e.g. preparing and cooking foods at home, consumption of herbs and vegetables), there also are some traditions that are less aligned to evidence-based nutrition, such as “over consumption of white rice”, “frying vegetables for a long period of time”, “preparing oily foods”. Such practices could be modified via informing students or through education from earlier stages of life. In addition experts reported that food educators need to be informed about reliable sources of food and nutrition information, such as appropriate websites and magazines, so that they may inform students and regularly warn students about inappropriate sources of nutrition information.

Some people may think that beliefs and traditions are always correct. They think these traditions are correct because they have been generated from hundred years ago and their parents have used them as well. However, they might not be correct. Kids should know this issue and need to be able to distinguish between ... traditions. (5-J)

Some assume that to be fit they need to eliminate carbohydrates from their diet and should mainly consume proteins ... Unfortunately some gyms give these recommendations. (5-J)

In summary, experts identified interventions for nutrition and food systems education at the school level, which could ultimately improve students knowledge before school-leaving age.

Organizing theme 3: Supportive environment

The need for a supportive environment to improve school-leavers’ knowledge of nutrition and food systems was identified. Three determinants of a supportive environment were discussed.

The first determinant was sufficient funding for food-related education programs at schools. It was considered to be the responsibility of the national government to provide such funding, which should be directed to skill-based education

programs and workshops for students and teachers in nutrition and food systems domains.

Owing to lack of funds, we don't have enough skill-based courses at schools and all we have is theoretical training. For example, kids do not have any knowledge about gardening. (23-R & Sh)

The second determinant of a supportive environment was the creation of positive activities around food and nutrition education programs in the mass media. Several experts stated that the mass media needs to provide continuous, diverse and recreational educational programs in nutrition and food systems fields. The experts foci were mostly related to increasing advertisements of healthy foods and healthy eating behaviors; documentaries related to the production of foods from farm to fork; and competitions for students at radio and television to test their nutrition and food systems knowledge.

We need to create a campaign to improve people's knowledge. Radio and television could have a fundamental role in this campaign ... We haven't done planned and coherent campaigns through mass media up to now. (11-SH)

The third determinant for a supportive environment was support from the national government to engage community-based organizations which are active in food and nutrition education programs.

Government needs to support institutes that are active in developing reliable journals, website and weblogs ... It is great to be in touch with students ... they show lots of interest ... Government supports could positively affect these institutions. (11-SH)

In summary, the experts reported the need for: further financial support of government for nutrition and food systems education programs; further incorporation of mass media in nutrition and food systems education programs; and governments' support of institutes which are active in community's food and nutrition education. These interventions together underscore the need to create

a wider supportive environment for nutrition and food systems education programs mainly by the national government in Iran.

9.5. Discussion

This investigation developed a guide of best strategies to improve school-leavers knowledge of nutrition and food systems. The study findings were compared to three international guides including World Health Organization information series on school health, document 4 (WHO, 1998), a logic model for community education program (Medeiros et al., 2005) and a holistic approach on knowledge in conjunction with learning (Yang, 2003). The experts' suggestions to improve school-leavers knowledge of nutrition and food systems were grouped into policy, process of education and supportive environment. These components collectively provide a basic framework to support nutrition and food systems education during schooling. Previous literature has reported separately on some of the components of such an education framework. To our knowledge, this is the first time a multi-level framework for strategies to improve school-leavers' knowledge of nutrition and food systems has been developed.

The component "Policy" incorporates policies that were identified as required to improve nutrition and food systems education programs at schools related to: creating a multidisciplinary team of key policy makers, acknowledged experts and educators across different nutrition and food systems domains; improvements in nutrition and food systems components of national education curricula and methods of delivering information, and other educational interventions for both students and teachers at the level of national. Earlier "policy-focused" studies have reported on food and nutrition policies at the level of schools, particularly those aimed at interventions to improve healthy eating behaviours among children (Agron et al., 2010; Acham et al., 2012; Belansky et al., 2013). However, this investigation has highlighted policies that could improve the quality of education initiatives. Some of these policies components have been reported in the international literature, including: the importance of skill-based education programs at schools such as gardening (Christian et al., 2014) and

cooking (Fisher et al., 2011); integrating nutrition topics with other subjects at schools (Carraway-Stage et al., 2015); employing various techniques for teaching purposes (WHO, 1998; Pérez-Rodrigo and Aranceta, 2001); and education of school teachers (WHO, 1998). However not all policies reported by participants in this study have been discussed previously.

“Process of education” in nutrition and food systems, the second organizing theme identified in this study reflected interventions that facilitate and improve the process of knowledge transference to students during schooling. A novel issue identified was the importance of attracting students’ attention to nutrition and food systems topics. There are some studies related to nutrition education at school which have previously highlighted the need for considering students’ interests in nutrition education programs (Pérez-Rodrigo and Aranceta, 2001; Pérez-Rodrigo and Aranceta, 2003). The other education concept identified by participants was related to the development of students’ critical thinking about nutrition and food systems issues. This is consistent with a study related to the management of science learning, which referred to critical thinking as a key element in children’s educational development at every stage of school (Chaipichit et al., 2015).

The third organizing theme presented in this study related to “supportive environments”. There were three major determinants deemed important facilitators of environment to improve nutrition and food systems education programs that reflect the system wide perspectives of the participants. The three determinants were financial support by governments for nutrition and food systems education programs, mass media activities, and government support for food and nutrition education institutions. Supportive environments for food and nutrition education programs at schools have been viewed differently in the literature. For example, a supportive environment largely reflects school level policies which lead to healthy dietary behaviors (Rowe et al., 2010; Hayati Adilin et al., 2015), such as accessibility, availability and affordability of healthy foods at school environment (Rowe et al., 2010). The higher level supportive environment as described in this study may reflect the interests and experiences of the expert

participants, who were in nationally recognized positions, or the particular needs and circumstances of nutrition and food systems education programs in the study country, Iran.

The key role of national government departments identified in this study also may reflect the “centralized type” education system of Iran and the role of central government in education-related decision-makings (Behbahani, 2010). Similar studies in other countries should incorporate exploration of the role/s of government agencies in the establishment of or support for changes in education programs needed to facilitate incorporation of nutrition and food system topics.

Overall, there is lack of such guides, presented in this study, in both developing and developed nations. This paper had a focus on Iran. However the basic framework for nutrition and food system education arising from this study’s findings might be helpful more widely and may inform international guides designed for education and learning purposes.

The present findings are consistent with the WHO document on school health, (document four) (WHO, 1998), particularly with regard to some of the interventions identified under “policy” and “process of education”. Similarities were relate to the importance of providing “practical” information for students rather than “scientific” details; training school teachers; and incorporating various methods for an effective education program. However, a major difference between the present study and the WHO report is that the WHO report focuses on health-related aspects of nutrition education at schools, while this study provides a broader view incorporating food-related education programs.

Similarly the basic framework developed through this study has several similarities with the logic model framework for community nutrition by Medeiros and colleagues (Medeiros et al., 2005). The logic model consists of the three major components inputs or resources (funding, human resources, equipment and curricula), out puts (educational programs and participants reached) and outcomes. In the basic framework developed in this study, various issues reported under the organizing themes of “supportive environment”,

“process of education” and “policy” align with “input” and “output” sections of the logic model. The qualitative nature of this study did not permit quantification of specific outcomes. However, the participants did identify desired knowledge in the nutrition and food systems domains. Achievement of this desired knowledge could be tracked in future studies to determine their importance in impacting behavioral and health outcomes.

The study findings also were reviewed using the holistic approach of Yang’s epistemology of knowledge (Yang, 2003). Based on this approach three facets of knowledge are considered: explicit or scientific aspects of knowledge; implicit or knowledge in practice; and emancipatory or value-based features of knowledge. In this study the participants identified the need for less theoretical food-related topics, an increase in practical and skill-based lessons, and the importance of motivational, skill-based and skill developing education programs. These suggestions align with the need for further focus on implicit knowledge and decrease in explicit information. Examples of value-based themes (emancipatory knowledge) were incorporated in all three components of the basic framework, including: nutrition and food systems education for all students; developing critical thinking in students; reflecting on beliefs and traditions; and support for community-based organizations that are active in food and nutrition education programs. In brief, the findings indicate the need for improvement and balance of the three facets of knowledge across nutrition and food system curricula.

9.6. Conclusion

This study developed a guide for strategies to improve Iranian school-leavers’ knowledge of nutrition and food systems, comprising three key elements of; policy, processes of education and supportive environment to be incorporated into current education programs. Findings of this study might inform international guides designed for education and learning purposes.

Chapter 10: Comparison of Australian and Iranian studies, part 1

This chapter presents a comparison of four published studies (four chapters), two related to Australia (chapters 4 and 6), and two related to Iran (chapters 7 and 9). This qualitative investigation compares the views of 21 Australian and 28 Iranian food professionals regarding important nutrition and food systems (N&FS) knowledge issues for school-leavers, and the best methods of educating adolescents about N&FS issues. Australia and Iran are compared as two case studies of a developed country and a developing country, respectively. This comparison is performed using the World Health Organization's (WHO's) Ottawa Charter. The five action areas of the Ottawa Charter used in this comparison investigation have formed a potential universal guide for N&FS education programs for secondary school students.

At the time of writing, this chapter is under the second round of review for publication in the *British Food Journal*, as a peer-reviewed conceptual paper. It is presented here with minimal modifications to formatting, related to referencing style and page layout, to create a cohesive document and to follow the University of Wollongong's recommended referencing style.

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Title for publication: Rethinking a framework for nutrition and food systems education using the Ottawa Charter

10.1. Abstract

Purpose: To develop a potential universal framework for nutrition and food system (N&FS) education through the exploration of two case studies from a developed and a developing country.

Design/methodology/approach: This investigation analyzed Australian and Iranian professionals' views of appropriate N&FS education programs for adolescents using the Ottawa Charter framework. The data used for this analysis have been previously reported and comprised 49 semi-structured interviews with prominent food-related professionals in Australia and Iran (21 in Australia and 28 in Iran).

Findings: Recommendations of Australian and Iranian professionals were grouped under: 1) build N&FS education policy (targeting secondary school curricula, schoolteachers and students); 2) create supportive environment for N&FS education (focusing on media and parents in Australia and media, government in Iran); 3) develop food-related skills through school-based activities; 4) strengthen community organisations for N&FS education; and 5) reorient cross-disciplinary actions in N&FS education (to cover various aspects of N&FS and empower N&FS education programs for students and teachers).

Originality/value: Utilising the Ottawa Charter in guiding N&FS education programs makes this investigation unique. Using well-recognised and multi-faceted guides such as the Ottawa Charter in N&FS education programs provides an integrated framework for comprehensive N&FS education that has potential for universal application. Development of such a framework is important to provide guidance to governments in meeting their responsibilities for comprehensive N&FS education. It may also empower, facilitate and redirect cross-disciplinary actions that aim to improve different population groups' knowledge of the N&FS.

Keywords: framework, nutrition and food systems, the Ottawa Charter

10.2. Introduction

Knowledge provides accurate and explanative information that enables individuals to take informed actions (Sharma et al., 2008).

In nutrition education literature it is highlighted that although nutrition knowledge is not sufficient to change dietary behaviours, it is still an essential precursor to behavioural change (Worsley, 2002). Dickson-Spillmann and Siegrist (2011) referred to two types of nutrition knowledge, declarative and procedural nutrition knowledge. These investigators defined declarative nutrition knowledge as knowing the “facts”, for example nutrient contents of fruits. Procedural nutrition knowledge is described as knowledge of how to adopt a healthy diet. These investigators highlighted that procedural nutrition knowledge is an important factor in relation to individuals’ dietary behaviours.

Recent studies related to both developed and developing countries have identified inadequate knowledge of adolescents about nutrition and food systems (N&FS) issues broadly (Ronto et al., 2016a; Nanayakkara et al., 2017; Sadegholvad et al., 2017b).

Adolescence is a period of increased responsibility and autonomy. During adolescence, young people gradually take over the responsibility for their own eating habits, health attitudes and behaviours. Habits adopted in this life stage are lifelong and influence further dietary and lifestyle behaviours (Milosavljević et al. 2015: 101).

Dietary behaviours established during adolescence period of life not only have a significant effect on health and wellbeing during adulthood (Guo et al., 2002; Guo et al., 2013) but also affect the sustainability of the food systems in future (Harmon and Maretzki, 2006b). In addition, dietary behaviours affect the sustainability of natural resources (Parrish, 2016) and the way farm animals are treated in food production systems (Miranda-de la Lama et al., 2017). A major purpose of educating adolescents about N&FS has been reported as improving informed food choices among individuals (Parrish et al., 2016). Some researchers have referred to nutrition education programs that enable and assist adolescents

to make healthier food options (Contento et al., 2006; Parrish et al., 2016). In addition, some investigators have raised the need to educate adolescents about food production systems in conjunction with food ethics (Harmon and Maretzki, 2006a; Sadegholvad et al., 2017e) to make them capable of informed food selections associated with environmental sustainability (Harmon and Maretzki, 2006d) and animal welfare (Sadegholvad et al., 2017e).

Although the importance of educating adolescents about N&FS issues is identified in literature (Parrish et al., 2016; Nanayakkara et al., 2017; Sadegholvad et al., 2017e), there is lack of universal guides for N&FS education programs for adolescents and other population groups. This study aimed to address this gap in literature.

Despite the established place of nutrition education in the health promotion domain (World Health Organization [WHO], 1998), and the core role of the Ottawa Charter in guiding health promotion practices (Nutbeam, 2008), the Ottawa Charter has not been used as a guide to inform strategic nutrition education studies. The Ottawa Charter framework has guided the development of health promotion concepts and public health activities since 1986 (Nutbeam, 2008; WHO, 2009). Researchers have applied the framework to public health nutrition (Flynn, 2015), nursing practices (Smith and Cusack, 2000), chronic diseases (Sindall, 2001), oral health (Watt, 2005) and other areas of health promotion. In public health nutrition a study by Flynn (2015) showed how action areas of the Ottawa Charter were able to explain a broad range of nutrition initiatives for better health. For example in relation to the “creating supportive environment”, this investigator referred to the “calorie menu labelling” policy (Flynn, 2015) and “evidence-based guidelines for healthy eating and infant feeding” were considered to illustrate the “developing personal skills” action area (Flynn, 2015). The extensive coverage, generalisability and broad relevance of this framework to health professionals were deemed relevant factors for the present study.

This study aimed to develop a potential universal guide for N&FS education programs for adolescents using the Ottawa Charter. The current study focused on Australia and Iran as two case studies from a developed and developing country.

The Ottawa Charter is a well recognised framework guiding the development of health promotion concepts and public health activities since 1986 (Nutbeam, 2008; WHO, 2009). Over the last three decades the action areas of Ottawa Charter have been used as a framework by researchers across the world in studies of public health nutrition (Flynn, 2015), nursing practices (Smith and Cusack, 2000), chronic diseases (Sindall, 2001), oral health (Watt, 2005) and other areas of health promotion. In public health nutrition a study by Flynn (Flynn, 2015) showed how action areas of the Ottawa Charter are able to explain a broad range of nutrition initiatives for better health. For example in relation to the “creating supportive environment”, this investigator referred to the “calorie menu labelling” policy and “evidence-based guidelines for healthy eating and infant feeding” were considered to illustrate the “developing personal skills” action area (Flynn, 2015). Utilising the Ottawa Charter in very different health-related domains by researchers from across the world reflects the extensive coverage, generalisability and broad relevance of this framework. However, despite the established place of nutrition education in the health promotion domain (WHO, 1998) and the core role of the Ottawa Charter in guiding health promotion practices (Nutbeam, 2008), the Ottawa Charter has not been used as a guide to inform strategic nutrition education studies. This study aimed to develop a potential universal guide for N&FS education programs for adolescents using the Ottawa Charter. The current study focused on Australia and Iran as two case studies from a developed and developing country.

It is notable that the current study focused on both nutrition education for better health outcomes and food systems education supportive of food ethics. This is consistent with a number of studies over recent years that highlighted the need to inform people about the effects of food selection, dietary behaviours and food production systems on environmental sustainability, local farmers, farm animals and other food-related value-based issues (Vidgen, 2016; Parrish et al., 2016;

Sadegholvad et al., 2017e). Thus the current investigation aimed to compare both health related and non-health related aspects of N&FS education in the context of the action areas of the Ottawa Charter.

10.3. Method

This study is a secondary analysis of data from four previous studies. These four studies explored essential nutrition and food systems (N&FS) knowledge issues for adolescents in Australia (Sadegholvad et al., 2017d) and Iran (Sadegholvad et al., 2017a), and best strategies to improve Australian (Sadegholvad et al., 2017c) and Iranian (Sadegholvad et al., 2016) adolescents' knowledge of N&FS. The major purpose of all studies was to explore experts' opinions relating to N&FS education programs for secondary school students in Australia and Iran. This study re-examined the data through using the Ottawa Charter for Health Promotion (WHO, 2009) as the framework to create action areas for educating adolescents about nutrition and food systems.

The data had been collected using semi-structured, face-to-face or telephone-based interviews with a total of 49 participants, 21 from Australia and 28 from Iran. The aim was to conduct the interviews in one developed and one developing country for comparison purposes. In order to conduct fluent interviews, the investigators of this study aimed to perform all the interviews in the native language of the selected countries. Iran was selected as the developing country for this investigation because the first author is fluent in Farsi. Australia was selected as the developed country as the study was being conducted by an Australian university.

Iranian food-related professionals were interviewed in 2012 and Australian food professionals during 2013-2014. To investigate various aspects of N&FS, prominent professionals from various food-related fields were recruited. A major group of participants were acknowledged academics (e.g. Head of the Schools and professors) from top ranked Australian and Iranian universities. The other group of participants comprised recognized experts (e.g. chairs or professionals with a few decades of experience) from governmental and non-governmental

organizations that were active in food and nutrition-related education programs, farm-animal welfare, welfare of consumers and suitability of environment. Purposive sampling technique was used (Coyne, 1997) to select the professionals. To recruit appropriate participants through web-based investigation of selected universities and organizations was performed. Professionals' years of experience and their contributions to N&FS education programs and relevant research were critical for selection.

Participants of both countries mainly belonged to the groups of: public health nutritionists, dietitians, nutritionists, food scientists, environmental scientists and veterinary physicians. In Australia, four home economists and one expert in public health were also interviewed. However, in Iran, four schoolteachers involved in food education programs and one agriculture scientist were included. Differences in area of proficiency of some of the interviewed participants in Australia and Iran were related to the accessibility of desired participants in each country.

Key research questions were:

- 1) What are the essential N&FS knowledge issues for school-leavers (adolescents)? Why?
- 2) Of the essential N&FS education programs for adolescents identified, which ones would be considered as the most important? Why?
- 3) What are the best strategies to improve school-leavers' (adolescents') knowledge of N&FS?
- 4) Is there anything that could be done differently to improve their knowledge?

The first and the second questions were used to develop two guides, one for Australia and one for Iran, revealing essential N&FS knowledge issues for Australian and Iranian adolescents. The third and the fourth questions were used in developing two guides, one for Australia and one for Iran, presenting best strategies to improve adolescents' knowledge of N&FS more broadly.

The contents of the Ottawa Charter were not integrated into interview questions. Very broad interview questions were used to avoid directing the interviewees' responses about essential N&FS knowledge issues for adolescents and best methods of educating them. The Ottawa Charter was used to compare the findings related to Australia and Iran to reveal to what extent the professionals' recommendations are consistent with the action areas of the Ottawa Charter.

Written or recorded consent was granted from each of the participants in Australia and Iran prior to the interviews. Ethics approvals for all studies were received from the Human Research Ethics Committee (Health and Medical) of the University of Wollongong (Approval No: HE12/277). Further details on recruited participants, designs of the studies, employed interview questions and data analysis are provided in studies of Sadegholvad et al (Sadegholvad et al., 2016; Sadegholvad et al., 2017a; Sadegholvad et al., 2017c; Sadegholvad et al., 2017d).

10.3.1 Data analysis

The action areas of the Ottawa Charter (WHO, 2009) were used to re-examine and compare the findings related to Australia and Iran to develop a potential universal guide for N&FS education programs.

Deductive thematic analysis approach was employed as it was relevant to examine an existing theoretical framework (the Ottawa Charter) in different circumstances (Vaismoradi et al. 2013). The goal of analysis was to "extend conceptually" a theoretical framework, using the framework to guides the discussion and interpretation of findings (Hsieh and Shannon, 2005).

The thematic analysis was performed in two stages. The first stage was reading and reviewing the findings related to the Australian and Iranian studies (Vaismoradi et al. 2013), and then grouping and labelling the themes by considering the action areas of the Ottawa Charter. The second stage was reviewing the original data sets related to Australian and Iranian studies to identify any potential missing theme/s in the first stage.

10.4. Results

Australian and Iranian professionals recommended a broad range of similar education strategies and essential components for curriculum to improve Australian and Iranian adolescents' knowledge of nutrition and food systems (N&FS). In addition, participants of each country suggested specific strategies and curriculum components for N&FS education programs of adolescents in their country. The recommendations of Australian and Iranian food-related professionals were compared within the action areas of the WHO's Ottawa Charter framework and transformed into a guide to educate Australian and Iranian adolescents about N&FS issues, depicted in Figure 10.1. The developed N&FS education guide included five action areas:

- 1) build N&FS education policy
- 2) create supportive environment for N&FS education
- 3) develop food-related skills through school-based activities
- 4) strengthen community organisations for N&FS education and a comparison of recommendations by Australian and Iranian professionals for each action area is described separately
- 5) reorient cross-disciplinary actions in N&FS education.

A comparison of recommendations by Australian and Iranian professionals for each action area is described separately.

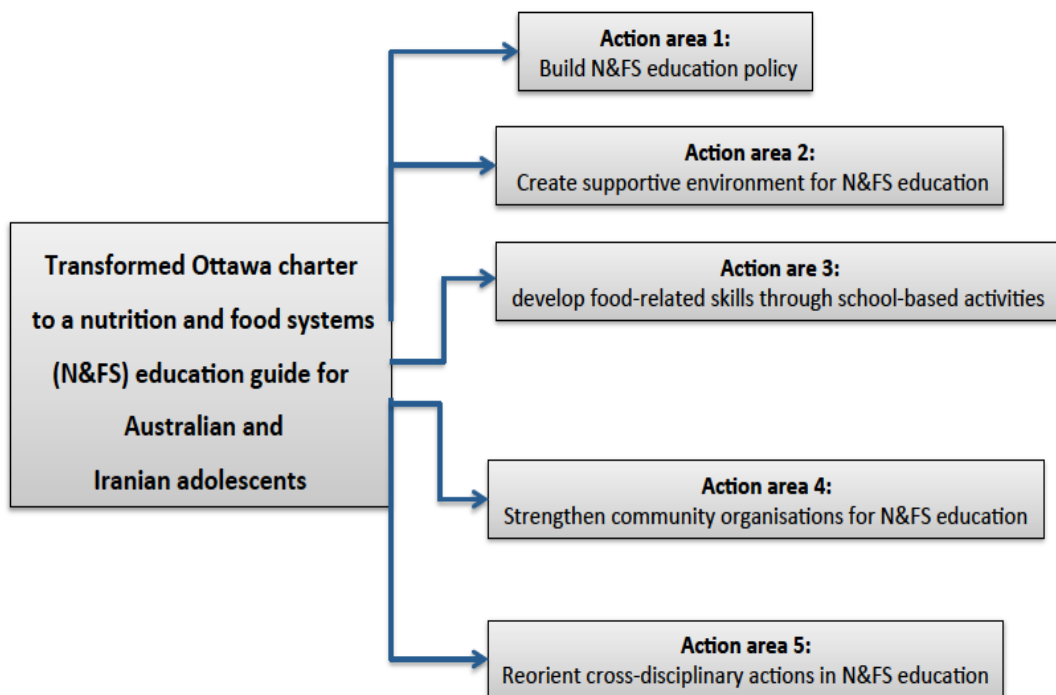


Figure 10.1 Depiction of how the Ottawa Charter was transformed to a nutrition and food system guide for educating adolescents

10.4.1 Action area 1: Build nutrition and food systems education policy

Recommendations of Australian and Iranian professionals in this area were related to:

- 1) upgrading the N&FS components of secondary school curriculum and integrating these components into core subjects
- 2) educating all schoolteachers and students about N&FS.

10.4.1.1. Upgrading nutrition and food systems components of secondary school curriculum and integrating these components into core subjects

In the “N&FS education policy” area, both Australian and Iranian professionals recommended integrating N&FS topics into current core subjects of secondary schools’ curricula in Australia and Iran. Another focus of professionals of both countries was upgrading the N&FS components of secondary school curricula. For example, increase in food systems lessons related to food production systems from farm to fork in conjunction with environmental sustainability and animal welfare was frequently highlighted by Australian and Iranian professional. However Australian professionals mentioned a broader range of food ethics topics for adolescents’ education programs.

The need to reduce unnecessary theoretical nutrition-related information was particularly highlighted by Iranian participants, which might reflect the current nature of school curricula in Iran.

The need to reduce unnecessary abstract nutrition science information was identified by interviewed food professionals. This point was particularly highlighted by Iranian participants who considered such information was in the current Iranian curriculum. Participants of both countries focused on simplifying food-related messages, avoiding technical information and educating adolescents about practical food issues for everyday life.

Recommendations of participants from both countries were consistent in relation to educating adolescents about current national policy guides in schools. Both Australian and Iranian professionals also highlighted the importance of including topics about nutrition requirements during pregnancy and informing adolescents about the importance of breastfeeding. However, an inconsistency was identified related to the Australian professionals’ suggestion to avoid ‘unnecessary’ information for adolescents like those related to the early parenthood. In contrast, Iranian professionals identified the nutritional needs of children under five as an essential topic for adolescents because they were likely

to become a parent in the near future. Moreover, Iranian participants raised the need to educate students about current nutrition-related health problems and modernisation and food transition in Iran toward consumption of junk foods, fast foods and highly processed foods.

Australian and Iranian professionals both reported the need to incorporate ethical food related issues to school-based education programs for adolescents. In this area Iranian professionals focused on farm animal welfare and environmental sustainability associated with food selection and food production systems. However, Australian professionals raised a broader range of food ethics considerations, such as the impacts of globalisation of the food supply on the environment and the economy; farm animal welfare; the importance of supporting local farmers; the importance of sustainable agriculture systems; food security issues; and the impacts of the global food transportation on the environment. Overall, Australian participants recommended more in-depth insight into value-based issues.

The shared recommendations were related to general information on food production systems and their impacts on environmental sustainability, animal welfare and food wastage. Added topics by Australian professionals were: globalisation of the food supply and its impacts on the economy and the environment; the environmental cost of global food transportation; sustainable agriculture vs. intensive agriculture; and food security on global and community levels.

Australian professionals and some Iranian professionals linked the food wastage concern to the environmental issues, and a few Iranian professionals expressed their concern within the context of religious beliefs.

10.4.1.2. Educating all schoolteachers and all students about nutrition and food systems

In the area of “N&FS education policy” another frequently reported recommendation by both Australian and Iranian food professionals was regular

training of schoolteachers in important N&FS issues. Professionals of both countries highlighted that regular training of teachers makes them more capable of educating students about essential N&FS issues. Australian and Iranian professionals claimed that at present it was unlikely that structured and coherent N&FS education programs for schoolteachers to update their knowledge of important N&FS issues were available. Both countries highlighted that it was important to provide N&FS lessons for all students regardless of their year of education and their schools.

10.4.2. *Action area 2: Create supportive environment for nutrition and food systems education*

Both Australian and Iranian participants referred to the importance of building an appropriate education environment to improve adolescents' knowledge of N&FS issues. The professional of both countries suggested the need to broadcast more positive food-related educational programs by Australian and Iranian mass medias. Australian professionals also recommended regular training of parents to enable them to act as appropriate role models and food educators within the home setting. However, Iranian professionals reported the need to increase funding by the national government for school-based N&FS education programs.

10.4.3. *Action area 3: Develop food-related skills through school-based activities*

The professionals of both countries recommended the need to increase school-based food-related skill building activities in relation to food selection, budget management, gardening, food preparation, food storage and food safety. However the importance of cooking skills was highlighted more by the Australia professionals and budget management skills were more the focus of Iranian professionals. Iranian participants highlighted that Iranian adolescents need to learn about food-related budget management skill to cope with the current economic constraints of a large population of Iranian families.

Regarding food safety skills, in addition to the general basic issues highlighted by participants of both countries, Iranian professionals' recommended particular food safety skills, which were specific to the food situation in Iran.

A difference in views of Australian and Iranian professionals in food skill area was related to the gardening practices. Both sets of participants recommended school-based gardening activities for students. Australian professionals considered that building this skill would result in improved healthy dietary behaviours. of adolescents. However Iranian professionals positioned improvements in adolescents' gardening skills, knowledge and attitude to support their future in farm-related occupations.

10.4.4. Action area 4: Strengthen community organisations for nutrition and food systems education

The WHO's Ottawa Charter included an action area on community actions, however this was not reported by Australian and Iranian professionals of our studies. Nevertheless in this area Iranian participants stated it is important that the national government advocates community-based organisations that are active in increasing adolescents and general public's awareness of N&FS issues. However, Australian professional neither referred to community-based organisation, nor community based actions that aim to improve the level of N&FS knowledge in the society.

10.4.5. Action area 5: Reorient cross-disciplinary actions in N&FS education

Australian food-related professionals raised the need to promote collaborations of universities, schools and departments of education, reflecting the broad and multidisciplinary nature of the N&FS topics. This cross-disciplinary collaboration was recommended to improve and update the N&FS components of school curriculum, to reinforce training programs for schoolteachers and to promote other N&FS education programs for adolescents. Iranian professionals also identified the need for further collaborations of Ministry of Health, Ministry of

Education and governmental and non-governmental food-related organisations to strengthen the process of improving Iranian students' knowledge of N&FS.

10.5. Discussion

This study undertook a secondary data analysis of interview data using the action areas of the Ottawa Charter, with the view to propose a universal N&FS education framework. A guide for N&FS education initiatives for adolescents was developed based on comparing two case studies from a developed (Australia) and a developing country (Iran). This N&FS education framework included five action areas:

- 1) build N&FS education policy (targeting secondary school curriculums, schoolteachers and students)
- 2) create supportive environment for N&FS education (focusing on media and parents in Australia and media, government in Iran)
- 3) develop food-related skills through school-based activities
- 4) strengthen community organisations for N&FS education
- 5) reorient cross-disciplinary actions in N&FS education (to cover various aspects of N&FS and empower N&FS education programs for students and teachers).

Overall a very wide range of similarities in recommendations of food professionals related to two very different countries (Australia and Iran) was identified. As these findings are sourced from countries with quite diverse cultures and developmental stages, they lend themselves to being more universally acceptable. In addition, five key components of the developed N&FS education guide in this investigation are developed based on the five action areas of the Ottawa Charter and each key components (action area) is very broad that has the potential to cover various cultural, economic, social and political aspects of food-related education programs. In fact, the action areas of the Ottawa Charter were not only capable of describing the similarities of findings related to these two countries but also well covered the differences between the two countries due to the generalisability and the universal nature of the Ottawa

charter. This may add to the generalisability of the developed N&FS education guide in this paper.

An explicit comparison of this study and studies that have developed broadly based frameworks for comprehensive approaches to N&FS education is not possible as such frameworks have not been reported. However specific components of identified education action areas have been reported. For example in relation to the first action area, “building N&FS education policy”, some aspects of the findings are consistent with a US study that identified the need to integrate N&FS topics into other core subjects in school curricula (Carraway-Stage et al., 2015) and also with calls in a recent food literacy publication (Helen Vidgen, 2016; Ronto et al., 2016b).

Regarding “building N&FS education policy”, both the Australian and Iranian professionals raised the importance of upgrading N&FS curriculum components particularly in relation to the food systems topics. Globally, there is lack of studies that have explored the components and extend of N&FS education programs across the different years of secondary school education.

In relation to upgrading curriculum components, both Australian and Iranian professionals underlined the need to educate adolescents about very specific topics such as nutrition requirements during pregnancy and the importance of breast-feeding. However previous studies have not explored these topics in relation to secondary school curricula. A topic for secondary school education programs where there were differences expressed between the two countries was related to nutrition education with a focus on early parenthood. Australian professionals referred to this topic as a kind of unnecessary focus for nutrition education of Australia adolescents, however Iranian professionals mentioned this topic as an essential one for Iranian adolescents. This nutrition education topic has not been focused by previous studies related to secondary school education programs. However, it is not surprising that Iranian professionals’ focused on this education topic due to the practice of people marrying at a younger age and earlier mean age of first child in some Iranian families

(Montazeri et al., 2016). “The rate of teen early marriage in rural and urban areas has been reported as 19.6 percent and 13.7 percent” (Montazeri et al., 2016: 1).

Another major component of “building N&FS education policy” recognized by professionals of both countries was educating schoolteachers about N&FS issues. This recommendation of Australian and Iranian professionals is consistent with several studies from across the world that have also identified the need to train schoolteachers about nutrition-related issues (O’Dea and Abraham, 2001; Chen et al., 2010; Sharma et al., 2013; Stage et al., 2016).

Both Australian and Iranian professionals identified the need to “create supportive environments for N&FS education”, the second action. Within this action area, the roles of mass media were raised, particularly the need to broadcast more educationally focused, food-related programs. This finding has also been raised by previous Australian (Reger et al., 1999), Iranian (Barzegari et al., 2011) and other international literature (Wakefield et al., 2010).

Australian professionals also highlighted the importance of focusing on improving the positive role of parents within the home setting as another way to create a supportive environment for N&FS education. This view is supported by previous Australian (Campbell et al., 2007) and international studies (Rathi et al., 2016). However, the Iranian professionals focused more on the role of national government, perhaps reflecting a narrower view of what comprised nutrition education, that provided by government in public settings, rather than a broader view of the Australian experts that nutrition education could encompass activities in the private setting of the home as well as the public domain. Iranian professionals proposed that the national government needed to increase their financial supports for school-based N&FS education programs in order to create a more supportive environment for N&FS education.

Australian professionals also highlighted the importance of focusing on improving the positive role of parents within the home setting as another way to create a supportive environment for N&FS education. This view is supported by previous Australian (Campbell et al., 2007) and international studies (Rathi et al.,

2016). However, the Iranian professionals did not raise the home environment as prominently. They focused more on the role of national government. Iranian professionals proposed that the national government needed to increase their financial supports for school-based N&FS education programs in order to create a more supportive environment for N&FS education.

The importance of “developing food-related skills through school-based activities”, the third action area, was highlighted by both Australian and Iranian professionals. This action area is supported by Australian professionals’ comments that recommended cooking, safe food storage (Fordyce-Voorham, 2011b), gardening, food selection and budget management skills (Fordyce-Voorham, 2011a) for Australian adolescents to support healthier dietary behaviours. However, skill-developing programs such as cooking, gardening and budget management targeting the Iranian adolescents have not been reported. This is in despite of the high prevalence of food insecurity among Iranian families, around 40% in urban areas of Iran (Hosseini et al., 2017) and the high rate of nutrients deficiencies among Iranian youths (Mirmiran et al., 2012; Doustmohammadian et al., 2013). Future studies related to Iran need to explore food-related skill building practices for Iranian adolescents.

“Strengthening community organisations active in N&FS education”, the fourth action area, was stressed by Iranian professionals. They acknowledged the importance of enhancing the process of transferring N&FS knowledge in Iranian adolescents and other population groups. Australian professionals did not refer to the need for strengthening community organisations or reinforcing community actions. However, the reporting of community actions supportive of N&FS education programs in Australia within existing literature, in particular community gardens (Kingsley et al., 2009; Litt et al., 2011), reflects stronger focus on this action area than in Iran. In addition, community-based organisations like ‘Nutrition Australia’ (Nutrition Australia) are active in community-based food-related education programs. Equivalent organisations do not appear to be very active in Iran.

The need to “reorient cross-disciplinary actions in N&FS education”, the fifth action area of the Ottawa Charter, was highlighted by both Australian and Iranian professionals. This action area has not been well addressed in food and nutrition education studies to date. Increased cross-disciplinary actions in N&FS education related to schools may create a better balance among offered lessons on traditional nutrition topics and those relating to food systems (e.g. food production systems and processes in conjunction with environmental suitability, animal welfare and other value-based food-related issues). It may also reduce the unde-representation of particular aspects of N&FS in education programs.

Despite Australia and Iran being two very different countries in culture, religion, and governance systems, their food professionals’ responses to very open questions resulted in quite similar recommendations. Any differences in the recommendations from Australian and Iranian food-related professionals were reflective of the countries’ economic, political and cultural circumstances. However, despite these dissimilarities, the Ottawa Charter was useful to inform an international guide for N&FS education programs. Notably, use of the Ottawa Charter framework also facilitated guidance with regard to the non-health related aspects of food education programs.

10.6. Conclusion

A broadly-based nutrition and food systems (N&FS) education guide for adolescents was developed in this study using the Ottawa Charter for Health Promotion framework. This guide may assist researchers and curriculum developers to build national and international N&FS education frameworks and hence lead to more systematic and targeted education initiatives. Utilising a well-established and multi-faceted framework such as the Ottawa Charter to guide N&FS education initiatives can enrich and support the breadth and provision of N&FS education initiatives and may reduce the under-representation of particular aspects of the nutrition and food system within education programs.

10.6.1 Implication for research and practice

This investigation for the first time has used the Ottawa Charter to offer a universal guide for broadly-based N&FS education programs. This guide is developed by re-examining and comparing the data related to previous Australian and Iranian investigations in a developed and a developing country. To the best of the authors' knowledge previous studies have not presented a wide comparison of appropriate N&FS education between a developed and a developing country. Using the universally known and applied Ottawa Charter may positively affect nutrition-related education programs to achieve better outcomes.

Chapter 11: Comparison of Australian and Iranian studies, part 2

This chapter presents a comparison of 21 Australian and 26 Iranian food professionals' perceptions regarding Australian and Iranian school-leavers' knowledge of nutrition and food systems (N&FS). This qualitative investigation identified similarities and differences in strengths and weaknesses of Australian and Iranian school-leavers' knowledge of N&FS. It also compared factors that affect the status of Australian and Iranian school-leavers' knowledge of N&FS. These findings are based on the Australian and Iranian food professionals' perceptions; actual assessments of Australian and Iranian school-leavers' knowledge of N&FS were not performed.

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Knowledge and education empower people to make informed healthy dietary and lifestyle choices in harmony with nature. (United Nations [UN], 2017).

Although knowledge is not sufficient to change people's dietary behaviours, it is still a key component of behaviour change (Worsley, 2002).

Recently, the literature has reported the importance of equipping adolescents with a broad range of knowledge on N&FS issues to enable them to make informed food choices that are supportive of health and ethical food behaviours (Parrish et al., 2016; Sadegholvad et al., 2017a). For example, knowledge of dietary guidelines, and the ability to read and understand food labels is recommended to assist adolescents in selecting healthier food options (Sadegholvad et al., 2017d). Knowledge of food production systems, in conjunction with food ethics, is highlighted in the literature as having the ability to enable adolescents to select environmentally friendly food products, locally produced crops and animal welfare friendly food options (Sadegholvad et al., 2017d). Very few studies have explored adolescents' knowledge of a range of N&FS issues. One study was conducted in Australia by Ronto and colleagues (2016a) and identified participants' poor knowledge in relation to reading and understating food labels and their lack of awareness of food ethics.

This paper aimed to compare the status of N&FS knowledge among adolescents in a developed and a developing country (respectively, Australia and Iran). The authors of this paper previously explored the gaps in N&FS knowledge of adolescents in Australia and Iran from the perspectives of 21 prominent food professionals in Australia (Sadegholvad et al., 2017e) and 26 in Iran (Sadegholvad et al., 2017b). This paper compared the similarities and differences in the findings related to Australia and Iran, as two case studies of a developed country and a developing country, respectively.

Iranian participants were recruited from dietitians, nutritionists, public health nutritionists, food scientists, schoolteachers, environmental scientists and veterinary physicians. Interviewees in Iran were selected from prominent

professionals from four of the major provinces including Tehran, Fars, Isfahan and Gilan. Semi-structured face-to-face or telephone interviews were conducted with Iranian participants in 2012. Selected interviewees were regularly in contact with young Iranians through different education programs and/or were active in food knowledge/education research.

Australian participants were recruited from home economists, public health nutritionists, food scientists, dietitians, nutritionists, public health experts, environmental scientists and veterinary physicians. Interviewees in Australia were selected from prominent professionals from New South Wales, Queensland, Victoria, Western Australia and the Australian Capital Territory.

Semi-structured face-to-face or telephone interviews were conducted with Australian participants during 2013 and 2014. Australian participants were involved in food knowledge/education research and/or were active in educating young Australians.

Ethics approvals for studies were granted from the Human Research Ethics Committee (Health and Medical) of the University of Wollongong (approval no. HE12/277). Further details on employed methods are provided in Sadegholvad et al. (Sadegholvad et al., 2017e) and Sadegholvad et al. (Sadegholvad et al., 2017b).

Overall, Australian and Iranian food professionals expressed serious concerns about Australian and Iranian adolescents' limited knowledge and skills about essential N&FS issues. The professionals from both countries stated that poor knowledge of N&FS would likely lead to less informed food choices among individuals. Australian nutrition researchers (Sadegholvad et al., 2017e) perceived that the poor N&FS knowledge of Australian adolescents was linked to a range of factors. Insufficient coverage of important N&FS topics and skills development courses in secondary school curricula was one of the identified factors. The other reported factors were insufficient levels of N&FS knowledge among schoolteachers in Australia and a lack of focus in some Australian schools on N&FS education programs. In addition, pervasive exposure of adolescents to

misleading food-related advertisements in Australia and lack of, or inconsistent, support from parents as informed food educators and in role modelling appropriate behaviours were identified as having an effect on adolescents' poor N&FS knowledge (Sadegholvad et al., 2017e).

Iranian food professionals (Sadegholvad et al., 2017b) had a similar view of Iranian adolescents' current knowledge and skills of N&FS issues. However, Iranian food professionals linked the poor and scattered knowledge and skills of Iranian adolescents on N&FS issues to the likely (competing) attractiveness of topics for adolescents and geographical location (rural or urban), in conjunction with family- and school-based factors (Sadegholvad et al., 2017b). These findings may add new aspects to the previously reported determinants of nutrition knowledge, such as gender, age and educational level (Hendrie et al., 2008a).

Australian and Iranian professionals both reported that they perceived there were significant knowledge gaps among adolescents regarding food production systems and food ethics. This view is consistent with a recent Australian study of food literacy by Ronto et al. (2016a) that indicated Australian adolescents had very limited knowledge of the "macro aspects of food literacy", like environmental sustainability and animal welfare. It is not known if a similar study exploring Iranians' knowledge of ethical food issues has been undertaken.

In the food production area, Yeatman (2016) claimed that awareness of food production systems can help individuals to identify the environmental and social aspects of their food choices. However, there is a scarcity of literature exploring Australian or Iranian adolescents' knowledge of food production processes and systems, and, therefore, the potential links between such knowledge and food choices.

Based on Yang's developed framework for knowledge (Yang, 2003) and its three facets for knowledge (explicit, implicit and emancipatory), both Australian and Iranian professionals considered adolescents to have poor implicit food knowledge. Implicit knowledge can support skill-based food practices like

gardening and cooking. Australian professionals identified that this knowledge gap was linked to insufficient skill development activities in schools.

According to the professionals in Australia and Iran, adolescents have poor knowledge of food ethics, which refers to emancipatory knowledge in Yang's framework (Yang, 2003). This knowledge may enable adolescents to make informed food choices from value-based perspectives.

A difference in perceived knowledge of Australian and Iranian adolescents was that in Australia they were considered to have some level of "explicit knowledge" in relation to nutrition basics, such as healthy versus unhealthy foods and the food pyramid, but their knowledge was not considered to cover various important aspects of nutritional health. This finding is relatively supported by a recent study of 131 adolescents in Australia (Ronto et al., 2016a). However, Iranian professionals assumed that "explicit knowledge" of Iranian adolescents about key nutritional health issues was very poor, and that they were not aware of basic topics, such as appropriate nutrition for growth. This perception of Iranian professionals is not consistent with findings of a recent study of householders' knowledge of micronutrients and food sources by Heshmat et al. (2016). However, Heshmat and colleagues studied Iranian households, not Iranian adolescents.

In summary, food professionals in Australia and Iran believed that adolescents have very poor knowledge of food production systems from farm to fork, environmental sustainability, animal welfare, and other food ethics. Australian professionals believed that, although Australian adolescents have some knowledge of general nutrition issues, their knowledge is not sufficient. Iranian professionals believed that Iranian adolescents' knowledge of general nutrition issues was not significant in most areas.

The findings raise concerns regarding how well prepared adolescents are to make the healthy and sustainable food choices that will impact on their own and their future families' health and wellbeing. A greater focus on food knowledge is warranted, to identify appropriate strategies that build people's capacities to

make informed choices, to inform education curricula and teacher education policies, and to complement wider public health initiatives that focus on healthier and supportive food environments.

This paper is based on exploring food professionals' perceptions of adolescents' knowledge. The authors did not explore adolescents' actual knowledge of N&FS. Future studies need to perform a precise examination of adolescents' knowledge of a broad range of N&FS issues.

Chapter 12: Discussion of key findings and conclusion

12.1. Overview of objectives

Knowledge of nutrition and food systems (N&FS) has been identified as necessary to enable people to make informed food choices (Harmon and Maretzki, 2006a; Parrish et al., 2016). However, globally peer-reviewed guidance incorporating a broad range of essential N&FS issues for education purposes are limited. This study addressed this gap in the literature by interviewing prominent professionals from various food-related areas to identify essential N&FS knowledge issues for school-leavers. The study focused on Australia and Iran, as two case studies of a developed country and a developing country, respectively. Findings from both countries were compared to identify similarities and differences and used to draft international guidance for N&FS education.

There has been a scarcity of studies exploring individuals' knowledge of a broad range of N&FS issues. An exception was a very recent Australian study of adolescents' food literacy by Ronto et al. (2016a), who identified adolescents had insufficient knowledge of N&FS issues. The current research, which preceded the study by Ronto et al. (2016a), addressed this gap by exploring food professionals' views regarding the strengths and weaknesses of Australian and Iranian school-leavers' knowledge of N&FS more broadly.

The other gap in N&FS education literature relates to the scarcity of peer-reviewed guidance regarding appropriate methods to assist secondary school students to learn about N&FS issues. This gap in literature was surprising given it was well-established that schools were an ideal setting for food-related education programs (Pérez-Rodrigo and Aranceta, 2001; World Health Organization [WHO], 1998). Previous studies had mainly recommended particular nutrition education methods (Powers et al., 2005) and mostly targeted younger children (Dudley et al., 2015).

To address this gap in literature, the current research explored the perspectives of Australian and Iranian food professionals regarding the best strategies to transfer important N&FS knowledge to adolescents during formal education.

12.2. Discussion of key findings

This research project included eight major findings that together informed five guides for N&FS education programs (two for Australia, two for Iran and one potentially universal guide). The research findings also revealed perceived gaps in Australian and Iranian school-leavers' knowledge of N&FS. Similarities and differences in perceived knowledge of Australian and Iranian school-leavers were identified as two case studies of a developed country and a developing country, respectively. The following sections briefly describe the eight key findings of this research briefly.

12.2.1. A guide presenting essential nutrition and food system components of secondary school curriculum in Australia

Recommendations of 21 prominent food professionals in Australia were used to develop a multidimensional framework of essential nutrition issues and important food system topics for secondary school education programs (Sadegholvad et al., 2017d: Chapter 4). This framework incorporated food systems knowledge and ethical issues with health-related aspects of food studies. Four main clusters were included in the framework:

- 1) "Key nutrition messages to support a healthy lifestyle"
- 2) "Skill development"
- 3) "Food ethics education"
- 4) "Foods from farm to plate".

Several components of the clusters "Key nutrition messages to support a healthy lifestyle" and "Skill development" had been reported in previous Australian studies; examples include school-based cooking and gardening activities for adolescents (Fordyce-Voorham, 2011). This research also identified new

components, such as educating senior secondary school students about nutrition requirements during pregnancy and the importance of breastfeeding.

The clusters “Food ethics education” and “Foods from farm to plate” were considerably under-reported in previous Australian and international literature on school-based food education programs. Together, the four clusters may guide the development and implementation of secondary school education programs to enable students to make more informed food choices, with the aim of supporting health and wellbeing, and to protect the environment, farm animal welfare, and local farmers.

12.2.2. A guide presenting essential nutrition and food system components of school curriculum in Iran (for both primary and secondary schools)

A guide including important knowledge on N&FS issues for educating Iranian students during formal education system was developed through this research (Sadegholvad et al., 2017a: Chapter 7). This guide included five clusters:

- 1) “Knowledge of nutrition basics”
- 2) “Food production”
- 3) “Every day food-related practices”
- 4) “Prevalent nutritional health problems in Iran”
- 5) “Ethical considerations in the food domain”.

The majority of components of these five clusters of knowledge were under-reported in previous Iranian studies on school-based N&FS education. The guide developed in this project (Sadegholvad et al., 2017a) is the first peer-reviewed framework regarding essential N&FS topics for school-based education programs in Iran.

12.2.3. Potentials gaps in Australian school-leavers' knowledge of nutrition and food systems

Previous literature outlined the problem of a lack of food-related education programs provided in schools in both developed (Kazemian et al., 2014) and developing countries (Carraway-Stage et al., 2015). A group of 21 prominent food experts in Australia expressed their views regarding the status of Australian school-leavers' knowledge of N&FS (Sadegholvad et al., 2017e; Chapter 5 of this thesis). Participants believed that there were major structural and curriculum-based issues negatively affecting current N&FS education programs in schools in Australia. A key problem was a lack of consistent and sufficient educational programs regarding N&FS issues within Australian schools. The other major problem was identified as a lack of well-trained schoolteachers to educate students about important N&FS issues. A study related to Australia reported that not all schoolteachers in Australia received food and nutrition education during their university degrees (Elsden-Clifton et al., 2015).

Overall, Australian food professionals believed that Australian school-leavers' knowledge of N&FS was limited and not translatable to everyday food practices. A very recent Australian study confirmed secondary school students' inadequate N&FS knowledge, particularly in relation to food ethics (Ronto et al. 2016a).

The Australian food professionals also stated the factors that they considered affected the current knowledge of Australian school-leavers. The factors identified in this research had also been reported in previous Australian or international literature – for example, mass media and marketing systems (Hendrie et al., 2008a), parents' knowledge and practices (Rathi et al., 2016), and gender of school-leavers (Hendrie et al., 2008a).

12.2.4. Potentials gaps in Iranian school-leavers knowledge of nutrition and food systems

In the Iranian research, 26 prominent Iranian food professionals expressed their perspectives regarding the status of N&FS knowledge of school-leavers in Iran

(Sadegholvad et al., 2017b: Chapter 8). Overall, participants believed that Iranian school-leavers had poor knowledge of various N&FS issues, even in relation to very basic topics such as malnutrition. Almost all participating experts considered school-leavers had very limited knowledge of food systems (e.g. knowledge of food production, food processing and food impacts on the environment).

Previous Iranian studies had not explored adolescents' knowledge of the issues identified in this study, such as food and chronic diseases, nutrition for growth and development, nutrition in conjunction with malnutrition, and food production systems in conjunction with food ethics. In addition, the participants identified key determinants of N&FS knowledge among Iranian school-leavers, including the content of school books, family environment, mass media, attractiveness of food and nutrition topics for students, students' geographical location, and duration of education programs. Among the identified determinants of N&FS knowledge, some – such as the importance of contents of school books (Kazemian et al., 2014), activities of mass media (Amini et al., 2014), and family environments (Rathi et al., 2016) – had been identified in previous Iranian and international literature related to developing countries. Other determinants not previously reported (and/or not much reported) included the attractiveness of food and nutrition topics for students, students' geographical location, and duration of food and nutrition education programs provided for students.

12.2.5. A guide incorporating strategies to improve Australian school-leavers' knowledge of nutrition and food systems

The recommendations of 21 prominent food professionals in Australia regarding methods of educating secondary school students about N&FS issues resulted in the development of a guide comprising five major clusters and five sub-clusters (Sadegholvad et al., 2017c: Chapter 6). The major clusters were:

- 1) “Specific improvements in schools' core curricula”
- 2) “Pre-service and in-service training of school teachers about N&FS”

- 3) “Training students to develop a critical mind about N&FS issues”
- 4) “Multidisciplinary collaborations to improve school-based N&FS education”
- 5) “A supportive N&FS education environment for students”.

To the best of our knowledge, this is the first Australian study that covers a broad range of essential strategies that facilitate and improve the processes of N&FS education for adolescents. Some components of this guide were separately discussed in previous national and/or international literature. For example, previous studies identified the importance of equipping schoolteachers with suitable knowledge of nutrition (Chen et al., 2010), and the important role of parents to create and supportive N&FS education environment within the home setting (Fletcher et al., 2013; Rathi et al., 2016). However, issues not considered previously included increasing cross-disciplinary collaborations between schools, universities and departments of education, and the development of critical thinking in students regarding food ethics, food choices and food production.

12.2.6. A guide showing best strategies to improve Iranian school-leavers’ knowledge of nutrition and food safety

A group of 28 prominent food professionals in Iran suggested a number of strategies to improve Iranian school-leavers’ knowledge of N&FS (Sadegholvad et al., 2016: Chapter 9). The participants’ recommendations were incorporated into a guide that incorporated three major clusters/themes:

- 1) “Policy”
- 2) “Education processes”
- 3) “Supportive environments”.

These three major clusters, and several sub-clusters, identified in this study created a principal theme of a continuing, structured education program with multiple methods for transferring knowledge. This is the first study related to

Iran that has presented a multifaceted guide of appropriate techniques to educate students about important N&FS topics.

Some components of this guide were described in previous studies, including the importance of skill-based food education programs at schools (Fordyce-Voorham, 2011), integrating N&FS topics with other school subjects (Carraway-Stage et al., 2015), and the need to employ various techniques for teaching purposes (WHO, 1998). Sub-clusters not identified in previous literature included the importance of attracting students' attention to N&FS topics, and the need for Iran's national government to provide financial support for N&FS education programs.

12.2.7. A potential universal guide for nutrition and food systems education programs by using Ottawa Charter

A broad-based N&FS education guide was developed using the World Health Organization (WHO) Ottawa Charter for Health Promotion (see Chapter 10) framework to collate the Australian and Iranian studies' findings. This guide included five areas of action:

- 1) build N&FS education policy (targeting secondary school curriculums, schoolteachers and students)
- 2) create supportive environment for N&FS education (focusing on media and parents in Australia and media, government in Iran)
- 3) develop food-related skills through school-based activities
- 4) strengthen community organisations' support for N&FS education
- 5) reorient cross-disciplinary actions in N&FS education (to cover various aspects of N&FS and empower N&FS education programs for students and teachers).

Although the Ottawa Charter was well-established in guiding actions related to health promotion (Nutbeam, 2008), previous studies had not used the Ottawa Charter in guiding nutrition education programs. Incorporation of findings from

both a developed country and a developing country increases the global relevance of the guide.

12.2.8. Comparison of perceived gaps in Australian and Iranian school-leavers' knowledge of nutrition and food systems: two case studies

This research assessed the similarities and differences in perceived N&FS knowledge gaps between Australian and Iranian school-leavers (see Chapter 11). This study showed that 21 food-related professionals in Australia and 26 in Iran believed that school-leavers had very poor knowledge of several key N&FS areas, including food production systems from farm to fork, environmental sustainability, animal welfare and food ethics. Australian professionals believed that, although Australian adolescents had some knowledge of general nutrition issues, their knowledge was insufficient. Iranian professionals believed that Iranian adolescents' knowledge of general nutrition issues was not significant in most areas. To our knowledge, this was the first study to compare the views of experts from a developed country and a developing country about adolescents' broad knowledge of N&FS.

12.3. Significance of this research

Across the world there has been a very limited number of guides for N&FS education programs. This research has drafted five guides to assist food and nutrition educators, school curriculum developers, and relevant policymakers in their initiatives to improve N&FS education programs for adolescents. These guides aim to assist the articulation of broad-based N&FS knowledge acquisition into school curriculum policies and education documents for secondary schools.

Two draft guides were developed for Australia. One of the Australian guides incorporated essential N&FS components of secondary school education programs. For the first time, food production and food ethics education were identified. The guide envisaged a broad range of food ethics issues, including simple animal welfare messages about the treatment of animals in food

production systems, globalisation of the food supply and its impacts on the economy and the environment, the environmental cost of global food transportation, the importance of supporting local farmers and small local businesses, sustainable agriculture versus intensive agriculture, the effects of food wastage and food packaging on the environment, and the impact of food security on global and community levels. The second draft Australian guide presented a multidimensional approach and incorporated a wide range of techniques required to efficiently support secondary school students in learning about N&FS.

Two draft guides were developed for Iran. For the first time, scholarly guidance has been developed that covers essential N&FS components for school curricula in Iran to support curriculum development and, more broadly, N&FS education programs in Iran. In addition, and again for the first time, this research provided a scholarly guide of the best strategies to improve Iranian school-leavers' knowledge of N&FS.

Furthermore, this was the first research to compare the views of experts from a developed country and a developing country. There were multiple areas in common regarding essential components for secondary school curricula, including general nutrition knowledge (e.g. national dietary guidelines), nutrition requirements during pregnancy and informing adolescents about the importance of breastfeeding, food skills (e.g. gardening, food selection, food preparation, food safety and storage), knowledge of food production systems, and food knowledge associated with farm animal welfare and environmental sustainability. There were also multiple areas in common regarding essential strategies to improve school-leavers' knowledge of N&FS, such as upgrading N&FS curriculum components, particularly in relation to the food systems topics; increases in school-based food-related skill building activities; further cross-disciplinary collaboration of universities, schools and departments of education; and broadcasting more positive food-related educational programs through media.

Issues were identified as being pertinent to the different countries – for example, further financial support of the Iranian national government in relation to N&FS

education programs for students, the need to strengthen community organisations in Iran that are active in N&FS education, the need to reduce unnecessary theoretical nutrition information in schoolbooks in Iran, and the importance of educating Iranian adolescents about nutrition requirements for early parenthood. This variation in findings across the two countries showed their adolescents have different needs in relation to N&FS knowledge, and confirms the important contributions that can be made by such comparative studies.

Lastly, this study used the Ottawa Charter to develop a potential universal guide for N&FS education for adolescents. Using a well-established and multidimensional guide like the Ottawa Charter may provide guidance to governments in meeting their responsibilities for comprehensive N&FS education. In addition, it may improve cross-disciplinary actions that aim to improve N&FS knowledge of different population groups. Nutrition education professionals may benefit from considering their use of existing guidance and frameworks from different but related fields, such as health promotion, to inform their future practices.

12.4. Limitations of this research

The range and variety of the participants' recommendations in this research was affected by the nature of the participants' professions. Recruiting participants from other groups of food professionals – for example, senior physical education teachers and agronomists – may provide a broader range of recommendations to enhance N&FS knowledge and skills. Unfortunately, none of the preselected Australian health teachers in Australia accepted the invitation to be interviewed as part of this research. Thus, this group of professionals, who were in direct contact with students at schools, was not represented in this research.

The other limitation of this study was that food professionals' views regarding current N&FS knowledge of Australian and Iranian school-leavers were explored but school-leavers' actual knowledge and skills in N&FS issues were not assessed. The Australian and Iranian participants, while experts in their professional fields,

may have varying familiarity with school-leavers' actual level of N&FS knowledge.

Furthermore, interviews related to the Australian study commenced in 2012 and finished in 2014. A national school curriculum in Australia was introduced after the collection of data in this study, and it was not clear the extent to which the participants' issues had been addressed in the new curriculum, which was in the implementation phase.

It would have been desirable to review the findings of this research with the participants. However, due to the long period of time allocated to include all of the Australian participants during the data collection, the additional time needed for such review was not possible.

12.5. Conclusions

Globally, a limited number of studies explored a broad range of essential N&FS issues for adolescents. Further, a very limited number of investigations explored the status of adolescents' knowledge of a broad range of important N&FS issues. This gap in the literature was also significant in terms of studies that identified the best educational strategies to assist adolescents to learn about N&FS.

This PhD research investigated the perceptions of Australian and Iranian professionals (as two case studies of a developed country and a developing country, respectively) about the essential N&FS knowledge issues for adolescents and best strategies to transfer the essential information to adolescents during formal education. Recommendations of Australian and Iranian food professionals led to development of five scholarly guides presenting essential N&FS knowledge issues for Australian adolescents, best strategies to improve Australian adolescents' knowledge of N&FS, essential N&FS knowledge issues for Iranian adolescents, best strategies to improve Iranian adolescents' knowledge of N&FS, and a universal framework for N&FS education for adolescents (by comparing the Australian and Iranian guides and using the Ottawa Charter). These guides will assist food and nutrition educators, school curriculum developers, and

relevant policymakers in improving N&FS education programs for secondary schools in Australia, Iran and internationally.

This PhD research also explored Australian and Iranian food professionals' views on the status of Australian and Iranian adolescents' knowledge of N&FS. Food professionals expressed their views regarding the strengths and weaknesses in adolescents' knowledge of N&FS in Australia and Iran. These findings suggested potentially neglected components of N&FS education within current Australian and Iranian school curricula. In addition, these findings provide important insights for N&FS curriculum developers and education policymakers to improve school-based N&FS education programs in Australia and Iran.

12.6. Future studies

Future studies should perform a systematic investigation of current N&FS components of school curricula to specify the strengths and gaps regarding N&FS components. It would also be important to explore schoolteachers' views regarding N&FS components of school curricula, based on their fundamental role in educating adolescents.

It is necessary to identify how confident and informed schoolteachers are in educating students about N&FS topics. It is also critical to measure secondary school students' current knowledge of the wide range of important N&FS issues.

To gain a greater understanding of what is possible to include and to undertake in N&FS education in schools, nutrition researchers need to identify the average number of school hours that are currently allocated for N&FS education programs in primary and secondary schools in Australia and Iran, and the allocation to N&FS topics within the primary and secondary schools' curricula in Australia and Iran.

12.7. Recommendations

This research has identified important (perceived) gaps in N&FS education in both Australia and Iran. To overcome such deficiencies, departments of

education and universities need to work together. N&FS curricula would benefit from inclusion of food production systems and food ethics components. To ensure effective implementation of N&FS curricula, secondary school teachers in Australia and Iran need to be trained in, and updated about, important N&FS issues and appropriate methods of education, on a regular basis.

Improvement of parents' awareness of important N&FS issues would enable them to act as food educators and role models within the home setting and to reinforce N&FS education that is provided in school settings. Furthermore, strategies to work with the Australian and Iranian mass media to broadcast more positive, educational programs focusing on N&FS issues would act to reinforce N&FS education in schools.

Finally, Iranian curriculum developers and relevant policymakers need to achieve a balance of scientific nutrition information and simple and practical skills components that are useful for everyday. School curricula in Iran may benefit from inclusion of more food-related skill-based activities such as cooking and gardening. Moreover, N&FS education in schools would benefit from Iran's national government giving more focused attention to the supports it can provide for the development of N&FS education programs for students.

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Appendix 1: Chapter 4 published as journal article



Article

What Should Be Taught in Secondary Schools' Nutrition and Food Systems Education? Views from Prominent Food-Related Professionals in Australia

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Abstract: Education can help young people to attain the knowledge and the skills that they need to make proper food choices and develop lifelong healthy eating patterns. This study explored the perspectives of prominent food-related professionals in Australia regarding essential nutrition and food systems (N&FS) education programs for adolescents during formal education. Semi-structured interviews were conducted with 21 prominent food-related professionals in Australia. Interview transcripts were analysed thematically. Four essential areas for N&FS education programs were identified. (1) Key nutrition messages to a healthy lifestyle; (2) Skill development programs to enhance health and wellbeing; (3) Ethical food-related lessons to support environmental sustainability, farm animal welfare, local producers, and food security; and, (4) Introductory lessons about foods from farm to plate to facilitate more informed food choices. Findings of this study may provide new insights for curriculum developers in Australia for further assessment of the current gaps in N&FS components of secondary school curriculum. Integration of these four areas into secondary school curricula has the potential to enhance adolescents' knowledge of important scientific and ethical issues in a range of N&FS fields, and enable them to develop fundamental food-related life skills that are supportive of health and wellbeing.

Keywords: nutrition; food systems; education; secondary schools; and adolescents

1. Introduction

Globally, unhealthy dietary patterns and sedentary behaviours are known as leading risk factors for health and wellbeing. Rapid urbanisation, changing lifestyles, and increased the production and ready availability of highly processed foods have shifted people's dietary patterns. This dietary has increased the consumption of fats, energy-dense foods, and for many people, the inadequate consumption of vegetables, fruits, and whole grains [1]. The Australian population does not consume recommended amounts of different food groups [2]. Less than four percent consume the recommended amounts of vegetables, legumes, and beans; only 30% meet the recommendation for fruits; around 30% meet the recommendation for grain; and approximately 35% of the total daily energy intake of Australians comes from discretionary foods, like sugar sweetened beverages, cakes, and confectionery [2].

Dietary behaviours during adolescence contribute to the establishment of lifelong eating patterns [3]. Unfortunately, the dietary behaviours of a large proportion of Australian adolescents deviate from the national dietary recommendations [4] and increase their risks of nutrition-related health problems, like obesity and insulin resistance [4].

Healthy eating habit among adolescents and children are essential for healthy growth, cognitive development and other aspects of health and wellbeing [5]. In addition, adaption of healthy eating habit has been linked to reduced risk of chronic diseases in their future life [5].

As Story et al. note: “Nutrition education can help young people attain the knowledge and skills they need to make healthful food choices and develop lifelong healthy eating patterns. Schools are ideal settings for nutrition education because they reach most youth, and nutrition fits into several subject areas including health, science, and consumer science” [6] (p. 121).

School-based nutrition education curricula should aim to improve students’ knowledge, skills, self-efficacy, and behaviour aligned with the dietary guidelines [7]. However, schools in many western [7–9] and non-western countries [10] have not used their potential to deliver food-related education programs [7–10] a review study of adolescents’ food literacy programs [11] identified lack of effective programs for adolescents, and uncovered the greater focus of current programs to educate younger adolescents rather than older adolescents [11].

Globally, the major focus of current school-based education programs has been on promoting healthy dietary behaviours [12–15], and Australian investigators have also shown a similar trend in their studies [16–18]. However, some nutrition researchers have argued that nutrition education programs should not be limited to health-related aspects of food consumption [19–24]. These educators highlighted the need to educate students [19,22,24,25], or more broadly consumers, about food systems-related issues [21,23,26], covering production, processing, packaging, distribution, retailing, consumption, and wastage of food [27]. A major reason for this emphasis on the different aspects of food systems is to promote informed food choices that aim to sustain and protect the environment.

It is well-established that food production and consumption impact the environmental sustainability [23,28,29]. For example, current agricultural practices are contributing to greenhouse gas emissions, excess water use and land degradation [27,30,31]. Consequently, the dietary patterns and food choices that are more supportive of environmental sustainability are recommended [27,28]. Australians’ current eating patterns pose risks to both environmental sustainability and people’s health [27]. For example, in a very recent literature the problem of excess energy intake in western diets, including Australia is reported. In this literature it is highlighted that discretionary foods not only contribute to increased energy intake while lack the nutrients, but also “inflate environmental burdens of diets” [32].

Western and non-western studies have reported the importance of food systems knowledge and relevant education programs to make more informed food choices [19,21,24]. However, previous researches have not shown significant attention toward school-based food systems education programs. The majority of nutrition education programs within the school setting mainly aim to promote health-related aspects of dietary behaviours (e.g., [33–35]).

The importance of nutrition and food systems (N&FS) education has been highlighted by several studies as a mechanism to improve adolescents’ capacities to make more informed food choices [19,22,24,25]. Education about specific areas of the N&FS have been highlighted in the literature. For example, education on food groups and dietary guidelines to support adolescents in their selection of healthier food options and healthy eating patterns [24]. Awareness of the association between foods and the environment to promote food choices that are more supportive of environmental sustainability [22,24,25]. Education about the welfare of farm animals has been raised in literature to promote selection of animal-welfare friendly food products [22]. In addition, the importance of informing adolescents about the consequences of their food choices on local farmers has been highlighted [25].

Australian adolescent’s knowledge of some aspects of N&FS was explored in a recent study among 131 secondary school students aged 12–17 [36]. The study results showed participants’ very limited knowledge about food ethics (environmental sustainability and animal welfare) [36]. Findings of this study also revealed participants’ lack of understanding of information on food packages, which negatively affected the adolescents’ willingness to read food labels [36].

These findings are consistent with another study related to the Australia that explored Australian food professionals' views of Australian adolescents' knowledge of N&FS [26]. Food professionals in Sadegholvad and colleagues' study perceived that Australian adolescents, have insufficient knowledge of N&FS issues and knowledge shortage was particularly highlighted in relation to food production processes in conjunction with food ethics [26].

In the current curriculum for the secondary schools in Australia, there are two key areas where food and nutrition topics are covered, to some extent including 'Health and Physical Education' and 'Design and Technologies' [37]. However, it is unlikely that different components on N&FS, such as those relating to the connections among people's food choices, food production, and food ethics (e.g., environmental sustainability) are well addressed. In addition, it is not known what, if any, research informed the development of these curriculum areas. Also, the actual average hours currently allocated for N&FS education in different years in secondary schools across the Australia is not known. The qualitative study reported here aimed to focus on one part of the current gaps in literature related to the appropriate N&FS curriculum for secondary schools in Australia. This study addressed the perspectives of the prominent food-related professionals in Australia about essential N&FS components for secondary schools.

2. Materials and Methods

A group of prominent food-related professionals were recruited who had expertise in particular area(s) of nutrition and food systems (N&FS). The participants included nutritionists, dietitians, public health nutritionists, home economists, environmental scientists, agricultural scientists, and veterinary scientists (experts in animal welfare and farm animal production systems). Purposive sampling was used to select highly experienced professionals from each food-related discipline, [38]. The participants included: academics in top ranked universities of Australia; professionals who held key roles in well-recognised government and non-government organisations; as well as senior community nutrition educators/promoters in Australia. For this purpose a thorough investigation of the websites of all the relevant schools or departments related to major universities across Australia was performed. The profiles of academic staff were explored to identify the potential academic participants. A thorough web-based investigation of relevant government and non-government organisations in Australia was undertaken to select a group of non-academic professionals. A final list of forty potential participants was developed and confirmed by all of the authors of this study.

Ethics approval was provided from the Human Research Ethics Committee (Health and Medical) of the University of Wollongong (approval No.: HE12/277). Potential participants were invited via email. The professionals who accepted the invitation, received electronic versions of the information sheet, interview questions, and a consent form, one to two week(s) before each interview. Dates, times, and locations for all of the interviews were arranged via email.

All of the participants provided recorded verbal and/or written consent before and/or at the beginning of their interviews. Semi-structured face-to face ($n = 7$) or telephone-based ($n = 14$) interviews were conducted between August 2012 and March 2014 to explore the professionals' views of the essential components of education programs for secondary school students. The extended period of data collection reflected limited availabilities.

Very broad interview questions were used to minimise leading the conversations and to provide the opportunity for participants to refer to those parts of nutrition and food systems that were related to their area(s) of proficiency. Interview questions were designed by the authors of this study and were confirmed by four experienced nutrition-related academics at the University of Wollongong, who were experienced in conduction qualitative research.

Prior to this study, the interview questions were used in a similar study for interviewing 28 food-related professionals in Iran [24].

Two key open-ended questions and relevant prompts (if necessary) were used in all of the interviews. The key questions were:

- (1) What are the important nutrition and food systems (N&FS) knowledge issues for Australian school-leavers? Why?
- (2) Of the important N&FS education programs for high school students identified, which ones would you consider to be the most important? Why?

The participants were asked to focus on those areas of N&FS that were directly linked to their area(s) of expertise.

Simultaneous data collection and data analysis were performed to continue the interviews until saturation occurred [39]. Thematic saturation occurred after interviewing twenty-one participants [39]. The interviewed professionals included: four dietitians, four home economists, four nutritionists, three public health nutritionists, one public health expert, two food scientists, one environmental scientist, and two experts in animal welfare and animal-sourced food production systems.

Audio-recorded interviews were transcribed verbatim by a professional audio transcriber and crosschecked by the first author. Interview transcripts were analysed thematically [40] using NVivo 10, a qualitative data analysis package. Inductive thematic analysis was used resulting in the identified themes being strongly linked to the data themselves [40,41]. The data set was coded without using any pre-existing coding frame or analytic preconceptions, and the process of data analysis was completely data driven [40]. The analysis method undertaken included: reading and re-reading the interview transcripts; generating initial codes; identifying potential themes; reviewing themes; defining and naming themes; and, developing report [40]. In addition to the first analysis of the dataset, a second manual analysis of all the interview transcripts was performed to identify any potential new theme that was missed over the first analysis. Minor changes occurred after the second analysis. Identified themes were reviewed and areas of N&FS education were developed, named, and confirmed.

3. Results

The essential components for nutrition and food systems (N&FS) education programs for secondary school students identified by the participants were grouped into four areas. These areas were: (1) Key nutrition to support a healthy lifestyle; (2) skill development to enhance health and wellbeing; (3) ethical food-related components to support environmental sustainability, farm animal welfare, local producers, and food security; and, (4) introductory components about foods from farm to plate to make more informed food choices. Each of these areas is described separately below.

3.1. Key Nutrition Messages to Support a Healthy Lifestyle

The majority of the participants across the different groups of professionals referred to the basic recommendations of national policy guides as one of the most important components for school-based education programs. The aim was to develop a 'basic understanding' of healthy dietary recommendations among students. They believed that the 'core food groups' should be introduced as the 'building blocks' of nutrition education for the formal education system in Australia.

Some of the participants highlighted that the focus needed to be on 'basic' and 'simple' messages. They explained that it was not necessary for adolescents to know the details of the current dietary guidelines, but it was necessary for them to know "what are the core food groups", "roughly how much they need to eat to meet their health requirements", and "the equivalents" in each group. In this area some participants reported that adolescents need to know that they should consume 'plenty' of vegetables and legumes, 'balanced' amounts of cereals and fruits, 'smaller' amounts of animal-based products, and 'a little' amounts of healthy oils on a daily basis. They also reported the need to raise students' awareness of the relationships between each food group and people's health to encourage them "to consume a variety of all core food groups in balance".

"I think they should have at least basic knowledge of food groups and what the major nutrients sources are. So I don't think they need to even understand completely why they

need all different foods but at least have some concept of variety and, and what might be important in variety and, and probably an understanding of the core food groups so food groups that they actually may get nutrition from as opposed to a lot of the other things that they might be eating.”

—Dietitian

Two of the dietitians and one of the public health nutritionists underscored the important role of a “positive push” in nutrition education programs for children and adolescents. They considered that the nutrition-related messages needed to shift toward more positive and encouraging messages rather than negative and prohibiting ones.

“I think there needs to be a real positive push towards nutrition and health so that, not just always focusing on the negative that fats are bad, and too much energy is bad, and too many soft drinks are bad, often that’s the message kids get rather than you know what does a healthy nutritious diet look like and, and why is it important to be able to understand that.”

—Public health nutritionist

Some of the public health nutritionists, dietitians, nutritionists, and home economists also identified three other nutrition education issues for secondary school students. One was related to the importance of maintaining healthy weight through appropriate diet and physical activity without developing a negative body image. The second issue related to nutrition requirements during pregnancy, as there was the potential for adolescent pregnancy. The last highlighted issue was related to providing encouraging messages about the importance of breastfeeding to create a ‘positive attitude’ among Australian adolescents about this issue. Nutrition education in relation to pregnancy and breastfeeding was recommended for students who were studying in the last two years of secondary school.

“The average school-leaver needs to understand the needs to support a healthy pregnancy . . . They should consider the whole issue of breastfeeding. . . . most boys and girls have established their attitude toward breastfeeding by the time of 15 and 16. So young age group needs to be given some facts and information about the value and place of breastfeeding.”

—Nutritionist

Other participants commented on the importance of avoiding unnecessary information, using the example of nutrition for early parenthood. They believed it was more appropriate to provide this kind of information at more relevant stages of life (e.g., “when a person becomes pregnant”).

3.2. Skills Development Programs to Enhance Health and Wellbeing

Most of the participants, including home economists, public health nutritionists, dietitians, nutritionists, and the public health expert, underscored the need for adolescents to build and develop a range of essential food-related, life skills, supportive of healthy dietary practices in the secondary school. For example, it was noted that students needed to develop enough skills and confidence to enable them to take action for “what are we going to have for dinner tonight?” One of the dietitians expressed the view that the “old home economics education type model” is more useful for everyday life as compared to the “academic-based model of nutrition education” (implying a more science-based and theoretical approach).

These professionals identified a range of necessary skills from food ‘planning’ and ‘selection’, to ‘safe food storage’, and also the skills to grow vegetables. In some cases participants from the different groups of professionals gave specific attention to particular skill(s) (as mentioned in following paragraphs).

Most of the participants mentioned the need to enhance students’ understanding of food labels to make more informed food choices. Some of them also mentioned the need for developing skills to

‘critically interpret’ food labels to avoid being manipulated by the food industry. The public health expert noted that building food label interpretation skills among adolescents and other population groups “pushes the food industry to improve different aspects of their products”.

“They (students) need to understand food labelling and what marketing and branding is to make healthy food choices. They need to be educated in how to guide their way through food packages, labels and supermarket choices, so to be able to compare some of the kinds of food for the best option.”

—Public health nutritionist

Most of the home economists, public health nutritionists and nutritionists reported the need to offer budget management education to secondary school students to enable them to select, shop, and prepare affordable and healthy foods. Some of these professionals referred to a common view among some people in Australia that “it is expensive to eat healthy foods” and that this needed to be corrected. The budget management lessons they recommended should include “the best value seasonal ingredients”; “learn to freeze particular foods when they are cheap”; and, learn to select affordable alternatives (e.g., “canned lentils and beans as a cheap alternative to meat”).

“They need to learn to utilise those convenience foods judiciously not relying totally on frozen foods and canned foods but incorporate them because they often are nutritionally equivalent to fresh foods. For example, buying dried chick peas and soaking them overnight, a canned—alternative can be just as cheap, you can usually buy a can of chick peas or lentils for a dollar, so every now and again, you know if you had those sort of staples in your pantry that’s a really good thing to have on hand.”

—Home economist

In contrast, one of the nutritionists thought that budget management education was unnecessary. She expressed:

“I think that kind of stuff is boring and I, I think it will turn students off if that’s how you want to present food and nutrition is about budgeting on a, on a low budget.”

—Nutritionist

Other essential skill-development programs for students were reported, including: food preparation and cooking skills to provide ‘healthy’, ‘affordable’, ‘quick’, ‘simple’, ‘tasty’, and ‘attractive’ meals; and, food safety skills to ‘prepare’ and ‘keep foods safely’. In this study, food preparation and cooking skills (consistent with the Australian dietary guidelines); and skills to prepare and store foods safely were mentioned most frequently as the food skills that should be included in school education programs. Some of the interviewees explained that if the students are equipped with important textbook-based nutrition knowledge issues without building their food preparation skills, it will not be very useful for their everyday lives. For example, one of the dietitians mentioned that if students know that oily fish contains healthy oil and protein, but if they do not know how to prepare it in a tasty and healthy way, then it is not enough to encourage them to consume it on a regular basis.

“Preparation and presentation of foods for good health and satisfaction to support good and enjoyable eating experiences should be part of school-based education. . . . Food safety skills go hand-in-hand with cooking skills.”

—Home economist

Lastly, the home economists noted that cooking courses conducted by qualified teachers have the potential to train students about a range of other essential food knowledge issues and relevant skills, such as: food costs; affordable ingredients; recipe reading; principles of safe food preparation; nutrient

composition of meals; the importance of key nutrients for adolescents’ health; basic way to combine foods from the core food groups in a meal; and, healthy replacements in each food group.

Seven participants from groups of public health nutritionists, nutritionists, home economists, and a dietitian reported that it was important for schools to provide students with opportunities to develop skills for growing plant-based foods (in schools or any other available settings arranged by schools). Some participants also suggested that students should visit farms to become familiar with growing techniques. School-based gardening activities would encourage students to consume more plant-based products, increase familiarity with ‘farming practices’, and also inform students to consider gardening skills as a budget management strategy. However overall, growing foods was less frequently mentioned as compared to the other skills identified by the participants.

“I think children learn by experience so it would be useful for them to have practical experience in terms of food growing. It can be useful for families with limited resources. Students can grow certain vegetables at school, or visiting farms to understand a little bit about farming practices. I think children just don’t get enough exposure to that particularly kids in the city.”

—Public health nutritionist

3.3. *Ethical Food-Related Lessons to Support Environmental Sustainability, Farm Animal Welfare, Local Producers and Food Security*

Twelve participants (more than half of the participants) from across different groups underscored the need to educate secondary school students about value-based ethical issues that are associated with food production and consumption. They recommended the inclusion of ethics lessons that aimed to promote more informed food choices among young Australians to protect the environment, and farm animal welfare and local farmers, and to reduce food insecurity.

A summary of the ethical issues raised by the interviewees is presented in Table 1. All of the key food-related ethical issues presented in the Table 1 have same level of importance. In fact, the participant did not present a hierarchy of the most important ethical food-related issues for adolescents.

Table 1. Summary of the ethical issues raised by the participants.

Key Food-Related Ethical Issue for Secondary School Curriculum	Example of Quotes
Simple animal welfare messages about the treatment of animals in food production systems	“School-leavers need to know about animal welfare aspect of food production. The way, which they are born, reared, handled, transported and killed for food. In terms of intensive food production like laid hens for eggs and meat, or pigs for meat they are done indoor” —Animal welfare expert
Globalization of the food supply and its impacts on the economy and the environment	“... the way that food is distributed, imported and exported. Impacts on the local businesses, local farmers. The role of industry and jobs and people that are involved and affected. A broad understanding in the community of the food system” —Public health expert “For instance the fashion to produce super foods likes chia and quinoa. The consequences of that in terms of economic costs, social costs both in the places of production and in the local communities” —Public health nutritionist

Table 1. Cont.

Key Food-Related Ethical Issue for Secondary School Curriculum	Example of Quotes
The environmental cost of global food transportation	“They need to know about the environmental cost of transport, like climate change. . . . I don’t think the education system either provides them with enough input” —Environmental scientists
The importance of supporting local farmers and small local businesses	“They need to know if they don’t buy Australian made and choose food, which is coming from overseas what implications that has then for the farmers in Australia . . . ” —Dietitian
Sustainable agriculture vs. intensive agriculture	“I would like them to leave the school with some appreciation of sustainable agriculture not in great depth, but to know something about it” —Nutritionist
The effects of food wastage and food packaging on the environment	“Sharing the planet and having a responsible attitude towards food issues for example in terms of food wastage . . . also in relation to the environmental costs of over production . . . ” —Public health nutritionist
Food security on global and community levels	“They need to understand food security on a global level and bringing it right down to a community level in terms of sort of the most vulnerable people in certain communities such as homeless, unemployed and those kinds of high risk groups. Some schools encourage children to do community service and that’s a good experience for them, perhaps if they can go to a soup kitchen or to volunteer. I think all school children should volunteer to deliver meals on wheels to older people because then it develops a healthy respect across the generation” —Public health nutritionist

The professionals, who raised these ethical issues noted that the purpose of school education is not to train environmental scientists or experts in the globalisation of food systems. The messages needed to be informative and simple, but also limited. The importance of raising students’ basic awareness of ethical food-related issues was that it supports informed food choices among Australians.

3.4. Introductory Lessons about Foods from Farm to Plate to Make More Informed Food Choices

Most of the participants frequently reported that secondary school curricula needed to cover issues like: “where do foods come from?”, “how food is produced”, “what makes up a food product” and “which foods are manufactured”. Almost all of the interviewees reported that it was not appropriate at the secondary school-level to go into full details about foods journey from farm to plate. They made comments such as: “we have to be careful about the amount of details”; “really the basic stuff that kids don’t know is enough”; and “knowledge has to continue to building after people leave school”. A key purpose of secondary food curricula should be to enhance students’ basic understanding of current food production systems particularly in Australia and how the food production systems can affect human health. In addition, some of the professionals commented that raising high school students’ knowledge of current food production systems would enable students to develop a better understanding of the ethical issues linked to food production systems.

“If they eat bread then they need to know that that came from wheat and was made into flour and that was further processed and you know how it got to them.”

—Dietitian

4. Discussion

The findings reflected the perspectives of prominent food-related professionals in Australia regarding essential areas of nutrition and food systems (N&FS) for school-based education programs for Australian adolescents. Four essential areas emerged from the interview transcripts that reflected the broad role that food plays in young people's lives and the breadth of knowledge and skills required: (1) Key nutrition messages to support a healthy lifestyle; (2) Skill development programs; (3) Food Ethics education; and, (4) Foods from farm to plate. Although the first and second areas are explored in previous studies [11,17,36], this investigation added new findings that are related to these two areas to be considered for secondary school education programs. Few studies have focused on the third and fourth areas of knowledge (Food Ethics education and Foods from farm to plate) for school-based food education programs (e.g., [24]). One reason for this gap is the primary focus of the majority of the previous reported studies on educating students about nutrition for better health outcomes [24]. The current study revealed that professionals held a more holistic view on N&FS education for secondary school students when compared to previous studies [21,24].

This study identified all these four areas as essential for secondary school education programs. However, the majority of previous studies have shown significantly stronger attention Key nutrition messages to support a healthy lifestyle and Food skills for better health outcomes among adolescents [11,17] as compared to the Food Ethics and Foods' journey from farm to plate. Portraying these important areas together may provide new insights for curriculum developers in Australia to further assess the current gaps in secondary school curriculum.

The first identified area, 'Key nutrition messages to support a healthy lifestyle', mainly referred to the basic recommendations in the dietary guidelines, particularly in relation to the food group, is supported by previous literature [42–44]. However, the importance of educating senior high school students about nutrition requirements during pregnancy, identified in current study, has not been well addressed previously. The major focus of previous studies has been on nutrition education at the time or during the period of pregnancy [45,46], and not on preparation for pregnancy in the longer term. Recent Australian literature has identified the poor knowledge of pregnant women about important dietary recommendations [47]. The education of senior high-school students about the key nutrition requirements of pregnancy might positively impact the health status of young mums and their fetuses.

Continuing the theme of preparing for independent adult lives, the participants highlighted the need to create positive attitudes towards breastfeeding among senior secondary students. A study of women's reasons for ceasing breast feeding [48] revealed that women who had the intention to breastfeed before delivery were more likely to initiate and continue breastfeeding when compared to those who did not plan or those who were unsure whether to breast feed [48]. The fostering of positive attitudes towards breastfeeding during adolescence might increase women's intention to breast feed and men's support for women who breast feed. Future school-based nutrition education programs targeting senior high-school students might consider this issue further.

The second identified area was the importance of development of food-related skills to enhance healthy dietary behaviours, which is aligned with previous studies [17,49]. The participants of the current study presented a broad reflection of essential food skills, such as critical or analytic approach to shopping, or informed participation in the food marketplace and its link to the interpreting of food label information to identify healthy food options. The participants also reported the application of this critical approach in the interpretation of food labels for ethical considerations as related to food production and procurement. Complementing this analytic approach was the identified need for practical skills, such as budgeting, growing food, and cooking, as supported by other studies [17,21,24]. Particular skills were identified as important, as well as the associated considerations around that skill, for example food preparation requires consideration of the food components, food safety, and nutrient content, which facilitate the process of communicating various important food topics with students and shows the efficacy of recommendations for everyday practices.

Notably, most of the participants in the present study placed stronger emphasis on food preparation, cooking, and food safety practices when compared to other food skills. A similar finding was reported by Ronto et al [49] in their study of home economics teachers' views of food literacy. In addition, a recent review found a similar emphasis on food preparation skills [11]. In contrast to the review finding that most programs were directed towards younger adolescents, the present participants considered that these skills were necessary for all secondary school students with no preference toward younger adolescents.

The third identified area referred to the food ethics education. The current study provided a broad picture of important food-related ethical issues for secondary school education programs to support informed food choices among young Australian. There are very limited number of studies that referenced to the importance of ethic-based food related education within the school setting, such as those relating to animal welfare [36], environmental sustainability [25,36], and the supporting of local farmers [25,50]. In fact, the majority of investigations related to school-based education programs have greater focus on improving students' health outcomes [24]. However, studies underlined the importance of increased consumer awareness of animal welfare to encourage the purchasing of animal welfare friendly food products [51–53] and increased awareness of food and environmental sustainability to promote the transition toward ecologically sustainable diets [28,29].

A recent study of adolescents' food literacy in Australia showed that they have very limited knowledge of animal welfare and environmental sustainability issues [36]. However, another Australian study of 2204 adults showed that they were concerned about a variety of animal welfare and food-related environmental issues [29]. In contrast to our findings and to these two studies, a study related to Australia rated animal welfare and environmental sustainability as among the least important aspects of food literacy for secondary students from the perspectives of home economics teachers [49]. This might be linked to the nature of participants' professions and the depths of their knowledge of these issues.

The last essential area identified in the present study concerned the journey of foods from farm to plate. Previous studies had considerably less focus on the exploration of school-based education programs that are related to food production systems and their impacts on health, environment, local farmers, and other issues when compared the first and second areas identified in this study. This might be due to the dominant focus of schools and nutrition researchers on the health-related aspect of nutrition for better health outcomes in children and adolescents [22,24]. However, literature have documented the strong links between food production systems and human health [28,54]; food production sectors and environmental sustainability [27,30]; and, food production sectors and animal welfare [51,53]. Correspondingly, the need to increase students' awareness of these issues is reported in literature [24].

Overall, this study explored what experts considered to be essential knowledge areas that would facilitate informed food choice behaviours of young adults. A wide range of topics for food education programs of adolescents was identified as necessary, many of which were consistent with previous reported areas [17,24,26,36,49]. This study also identified other areas that are considered to be important for adolescents' education programs that have been less reported in previous studies, for example, educating senior adolescents about nutrition requirements during pregnancy and the importance of creating positive attitude about breastfeeding. Other less explored areas identified were the non-health aspects of food systems education, including food production and a broad approach to food ethics.

These findings also might be helpful for other countries. A similar study conducted by the same authors in Iran [24] reported a considerable overlap with the range of N&FS areas.

Although nutrition knowledge is a key component of health literacy [55] and has been identified as essential for behaviour change [56], knowledge alone is not sufficient to change health-related practices [56]. Other influential factors include price, convenience [57], and the availability of healthy options [58] need to be considered.

5. Conclusions

This study provided a framework of essential nutrition issues in conjunction with important food system topics for secondary school education programs, comprising four main areas. The development of this multidimensional guide, which incorporated food systems and ethical issues into health-related aspects of foods, occurred through interviewing different groups of food professionals. Several components of the 'Key nutrition messages to support a healthy lifestyle' and 'Skill development programs' in the current study are supported in previous literature. However, this study also added new components to these areas. 'Food Ethics education' and 'Foods from farm to plate', identified in current study are significantly underestimated in previous literature on school-based food education programs. Inclusion of all these four areas together in secondary school education programs may support the efficient interaction of the adolescents with food issues and may enable students to: make healthier food choices; to develop health promoting life skills; and, to make informed food choices that protect the environment, farm animal welfare, and local producers. Findings of this study may provide new insights for curriculum developers in Australia to further assess the strengths and gaps in N&FS components of the current secondary school curriculum.

The food professionals in this study were asked to express their opinion about essential N&FS knowledge issues for adolescents and were not asked to state their opinion regarding essential knowledge issues for children or adults more broadly. Future studies could target younger children's N&FS education or N&FS components of primary school curriculum.

Limitations:

This study has contributed to one part of the picture of nutrition and food systems (N&FS) education in Australia. Other parts need to be identified by future studies beyond the professionals' views of essential N&FS knowledge issues for adolescents. A systematic investigation of current N&FS components of school curriculum would be useful to specify the strengths and gaps regarding N&FS areas. How the current curriculum was developed and which groups of experts were involved in the development should be explored. It would also be very important to explore schoolteachers' views regarding N&FS components of the school curriculum. At the same time, it is critical to identify how confident and informed schoolteachers are in educating adolescents about N&FS topics. Further areas for future research may also include: current knowledge of secondary school students of wide range of important N&FS issues; the average school hours that are currently allocated for N&FS education programs in secondary schools in Australia; and, identification of the maximum time that secondary schools' curriculum in Australia can allocate for N&FS education.

Interviews commenced in 2012 and finished in 2014. A national school curriculum in Australia was introduced after the collection of data in this study and it is not clear the extent to which the participants' issues have been addressed in the new curriculum, which is still in the implementation phase.

It would have been desirable to review and discuss the findings of this study with the participants. However, as reflected in the long period of time necessary to include all of the participants for data collection, the additional time required for such a review was not feasible.

The variety of the recommendations of the participants and identified themes in this study largely depend on the nature of the participants' professions. Broader sampling of other food professionals, for example agronomists and senior physical education teachers, may provide a broader set of knowledge and skill recommendations.

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analysis. Sanaz Sadeghohvad developed the first manuscript, and then authors reviewed and improved the final manuscript.

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Appendix 2: Chapter 5 published as journal article

SCHOOL CHILDREN AND ADOLESCENTS

Experts' views regarding Australian school-leavers' knowledge of nutrition and food systems

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The Australian government has identified chronic diseases and conditions as a National Health Priority Area (NHPA) that requires particular attention because of the substantial burden they impose on the Australian population.¹ At least four of the nine NHPAs,¹ cardiovascular disease, obesity, diabetes mellitus, and cancers, are affected by dietary intakes.² Weight gain and diabetes mellitus can occur due to over consumption of foods high in sugar, fat, salt and low in micronutrients.³ Risk of cardiovascular diseases increases with high intake of salt, saturated fats, trans fats and low intake of fruits and vegetables.² Low intakes of fruit and vegetables increase the risk of some types of cancers.² In Australia and globally, low consumption of fruit and vegetables together with high consumption of poor nutrient, energy-dense foods have generated major public health concerns.³ To support appropriate dietary intake, nutrition education programs have been developed for particular population groups or entire communities.⁴ Nutrition education in schools offers a unique opportunity to integrate the nutrition education and the application of that knowledge to achieve behavior change.^{5(p47)} Nutrition education in schools should not only provide nutrition information, but should also develop food-related skills and behaviour in relation to: food preparation, food storage, socio-cultural aspects of consumption, and to improve positive body image and self-esteem.⁶ Studies in both Western^{6,7} and non-Western⁸ societies report that food and nutrition education programs need to be reinforced in schools. While school-based nutrition

Abstract

Objective: To explore Australian experts' views regarding strengths and gaps in school-leavers' knowledge of nutrition and food systems (N&FS) and factors that influence that knowledge.

Method: Semi-structured interviews were conducted with 21 highly experienced food-related experts in Australia. Qualitative data were analysed thematically using Attride-Stirling's thematic network framework.

Results: Two global themes and several organising themes were identified. The first global theme, 'structural curriculum-based problems', emerged from three organising themes of: inconsistencies in provided food education programs at schools in Australia; insufficient coverage of food-related skills and food systems topics in school curricula; and the lack of trained school teachers. The second global theme, 'insufficient levels of school-leavers knowledge of N&FS', was generated from four organising themes, which together described Australian school-leavers' poor knowledge of N&FS more broadly and knowledge translation problem for everyday practices.

Conclusion: Study findings identified key problems relating to current school-based N&FS education programs in Australia and reported knowledge gaps in relation to N&FS among Australian school-leavers.

Implications: These findings provide important guidance for N&FS curriculum development, to clearly articulate broadly-based N&FS knowledge acquisition in curriculum policy and education documents for Australian schools.

Key words: Australian experts, school-leavers, nutrition and food systems (N&FS), knowledge

education interventions have been explored in Australia,^{9,10} gaps in school-based N&FS education programs and its association with current student knowledge of N&FS issues have not been explored more broadly.

Australian literature shows a broad assessment of Australians' knowledge of different aspects of food and nutrition to promote better health outcomes. For example: knowledge relating to understanding food labels in relation to health food choices;¹¹ knowledge of food safety to prevent food-borne illnesses;¹² knowledge of foods and nutrients in relation

to the risk of metabolic diseases;¹³ and general nutrition knowledge as one of several factors influencing dietary behaviour.¹⁴

While the focus of the majority of existing studies has been on nutrition knowledge to improve health conditions, more recently the Australian literature introduced the notion of environmental sustainability relating to dietary intake.¹⁵⁻¹⁷ In 2015, the Public Health Association of Australia published a document on ecologically sustainable diets, which supported integrating principles of ecological sustainability into Australian Dietary Guidelines.¹⁶ It stated that

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"ecologically sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable, nutritionally adequate, safe and healthy, while optimising natural and human resources".^{16(p.1)} However, the current Australian diet is not consistent with healthy dietary recommendations and does not support environmental sustainability.¹⁶

There is a lack of research addressing Australians' knowledge of a wide range of issues associated with food production from farm to fork in conjunction with sustainability of food production and environment. However, within both international and domestic literature there is reference to the effects of environment,¹⁸ natural resources¹⁸⁻¹⁹ and sustainability of food production.¹⁹

This study explored knowledge of traditional nutrition in conjunction with food systems to take a broader view of food-related issues. At present, specific aspects of food systems knowledge have been explored or incorporated into Australian literature. For example Worsley and colleagues explored Australian adults' knowledge of agriculture²⁰ and Taylor and Signal explored Australian consumers' self-reported knowledge of animal welfare and their willingness to pay for animal welfare friendly food products.²¹ However, to the best of our knowledge, literature assessing Australians' knowledge of a wide range of food systems issues is not available. Very limited studies world-wide have examined populations' knowledge of food systems. One exception is the study by Harmon and Maretzki who explored high school students' knowledge of food systems in relation to food systems sectors, sustainability, agriculture, food origins, local foods and hunger.²²

To address some of these gaps in the literature, particularly from Australia, this qualitative study aimed to explore the perspectives of experienced food-related experts in Australia regarding the strengths and weaknesses of school-leavers knowledge in relation to N&FS more broadly. This study also aimed to identify experts' views of the key determinants of current knowledge (and gaps in knowledge) of Australian school-leavers.

Method

To assess the broader aspects of nutrition and food systems, this study aimed to interview 20 prominent experts from various food-

related fields including public health nutrition, dietetics, nutrition science, food sciences, home economics, veterinary science and environmental sciences. Purposive sampling was used to recruit a group of acknowledged academics from top-ranked Australian universities,²³ and highly experienced experts from government and non-government organisations in Australia. Experts' years of experience and of their contributions to N&FS education programs and food-related research were determining for selection of participants. To identify the most appropriate participants from different groups of nutritionists, food scientists, environmental scientists, and other food-related experts, the first and second investigators of this study performed a thorough web-based investigation of staff profiles of all relevant schools or departments from top ranking Australian universities. Potential participants needed to be involved in food-related knowledge and/or education research in Australia and/or active in young Australians' education programs. Some of the participants were Heads of the schools and chairs. Overall, the positions of the majority of participants were at the top of the career hierarchy within their organisations. A similar web-based investigation was performed in relation to various Australian organisations that were active in nutrition education, health promotion, welfare of consumers, welfare of farm-animal and suitability of environment, aimed to identify proper participants. Afterward some of the potential participants were searched through research gate and LinkedIn for further assessment of their contributions to N&FS issues (e.g. their publications). The experts were selected from four States (New South Wales, Queensland, Victoria, Western Australia) and one Territory (Australian Capital Territory) of Australia.

Semi-structured interviews were conducted to explore experts' views regarding nutrition and food systems knowledge of Australian school-leavers and to identify key factors affecting their current knowledge. The interviews were conducted over an extended period, August 2012 to March 2014, due to constraints on availabilities of the lead researcher and of the research participants, all prominent experts in their field. The interviews were not conducted evenly over this time. The first and second authors invited the selected experts to participate by email. The dates and time for the interviews were then arranged by email. About 10 days prior to each interview the participant's

information sheet, interview questions and consent form were emailed to the participants. In addition, participants were asked to give their consent at the beginning of each interview, which was audio-recorded. Eight interviews were conducted face-to-face and 13 were telephone-based. The format of the interview was determined by participants' preference and/or the geographical location of the participants. The venues for face-to-face interviews were chosen based on interviewees' preferences. The first author undertook all interviews. Some of the participants were known to her through professional events or co-location at the same institution, but there was no prior professional relationship with any of the participants. Each interview lasted between 15 and 50 minutes. Recorded interviews were transcribed verbatim for analysis.

Ethics approval was obtained from the Human Research Ethics Committee at the University of Wollongong. The participants' identities were de-identified using numbers to preserve anonymity. Four broad open-ended questions were designed by investigators of this study and were reviewed by a panel of four acknowledged academics with strong food and nutrition background from University of Wollongong. Open-ended questions used for the interviewees were:

- What aspects of nutrition and food systems knowledge do you think school-leavers are well informed about?
- Why do you think their knowledge is good in these areas?
- What aspects of nutrition and food system knowledge do you think school-leavers are not well informed about?
- Why do you think their knowledge is poor in these areas?

Data analysis

Interview transcripts were analysed using the Attride-Stirling thematic network analysis framework.²⁴ This method provides a step-by-step guide for thematic analysis of qualitative data.²⁴ The first step involves reading and re-reading the interview transcripts to become familiar with the data and to identify lowest order codes (basic themes). The first author coded the data set and selected all of the basic themes after several reviews of the interview manuscripts. The second step was to identify the connected basic themes and group them together as middle-order themes (organising themes). The first and

the second authors reviewed the basic themes and agreed on the arrangement of organising themes and labels for them. The third step was related to the generation of the global themes. At this stage the main claims or the higher order themes were formed by appropriately grouping the organising themes. After generating all levels of themes, the transcripts were reviewed several times to check the thoroughness of the generated organising and global themes. Final agreement was reached in relation to the levels of themes, and labels for the organising and global themes.²⁴ Two global themes were generated in this study.

Results

Characteristics of the participants

Twenty-one experts were interviewed, at which point data saturation was achieved. The experts included: four home economists, three public health nutritionists, four nutritionists, four dietitians, two food scientists, one environmental scientist, two veterinary physicians (experts in animal farm food production systems and animal welfare issues) and one expert in population health. They were all, in some way, engaged in N&FS education programs in Australia, were regularly in contact with youth in Australia or were active in food-related issues associated with young adults. Their connections with young population groups were mainly through: teaching at universities and schools; engagement with food-related issues as food educators or informants in governmental and non-governmental organisations; or involvement in food knowledge research projects.

Thematic network

The experts' views of the current knowledge of Australian school-leavers about nutrition and food systems issues centred on two global themes and several organising themes. The first global theme was 'structural curriculum-based problems in current N&FS education programs at schools'. The second global theme was 'insufficient levels of school-leavers knowledge of N&FS'. These two global themes emerged from several organising themes. One of the emergent organising themes did not directly align with either of the formed global themes; 'competing roles of media and marketing and of schools in N&FS education'. All global and organising themes are explored below.

Global Theme 1. Structural curriculum-based problems in current N&FS education programs at schools

The interviewees believed that there are some 'inconsistencies in food education programs in Australian schools' (organising theme 1). They reported that students from different schools and students within different educational levels or years do not have the same exposure to nutrition-related education programs. For example, students have varying opportunities to experience: skill-based food education programs (e.g. cooking and gardening); educational excursions to visit the process of food production 'from farm to fork'; and preparation and analysis of food records. A structural issue that was not directly curriculum-based was identified relating to the role of school canteens. Some participants expressed a view that school canteens should promote healthy food and drink choices, which would be a mechanism to send nutritional health messages, however healthy canteens are not equally provided across all the Australian schools

"Kids in New South Wales could be in a school where there is no cooking involved, and if they do have cooking there's no specific area to do the food preparation, it might just be a converted classroom, it might just be for a couple of recipes only for one term." (Participant 2)

Some experts reported 'insufficient coverage of school-curricula of food-related skills and food systems topics' (Organising theme 2) due to crowded curriculum and lack of interest by curriculum developers and schools.

"Um, I don't think they learn about the food system at all. If they're lucky they might do some history sort of related to it but I don't think they learn anything about the food systems, and I think that's because it's not core curriculum." (Participant 10)

"We have a very crowded curriculum and often the food skills component is, is not really considered a priority in our schools today it's a life skill that's really important but many schools don't actually incorporate food skills as an important life skill because they're more focussed on academic." (Participant 3)

Interestingly, some participants commented on the lack of interest of food manufacturers to improve students' knowledge and concerns regarding particular foods, and their lack of involvements in school-based education. They considered it could be useful for some food manufacturers to engage in nutrition education initiatives so that young

people have a better understanding of the manufacturing and food processes.

"I don't think it's [food systems] considered important as part of school and I don't think there's a lot of reason for manufacturers themselves to promote that knowledge. So it's in nobody's interest to do it so it doesn't get done." (Participant 12)

'Lack of schoolteachers trained in N&FS' (Organising theme 3) was reported as a critical problem by home economists, public health nutritionists, dietitians and nutritionists. These experts believed that not all N&FS information provided by schoolteachers in Australia is thorough, accurate and updated enough to ensure school-leavers' knowledge of N&FS is at an appropriate level. Some of these interviewees related this problem to the lack of attention from the departments of education to monitor schoolteachers' knowledge of N&FS.

"This whole problem about food and nutrition is because they don't have a specialist teacher teaching it... On paper it looks right but in reality they're not getting the right people to deliver this message." (Participant 2)

Global Theme 2. Insufficient level of School-leavers knowledge of N&FS

The participants from different groups of experts believed that Australian school-leavers have 'generally, poor knowledge of N&FS' (organising theme 1). It was commonly assumed that school-leavers have some knowledge of very basic nutrition issues such as: healthy versus unhealthy foods; the food pyramid or the food plate; and dietary sources of vitamin D & C; but it was not sufficient overall.

"They are pretty informed about good and bad foods... things like fruit and vegetable are good for you." (Participant 16)

Informants believed that school-leavers lacked knowledge in relation to important nutrition issues such as: glycemic index; added sugar; added salt; nutrition during pregnancy; nutrition for early childhood; micronutrients deficiency especially in relation to iodine, iron and folic acid; and food storage, food hygiene and cross contamination. Interviewees reported they believed that Australian school-leavers had particularly poor knowledge in relation to food skills and food systems (particularly food production from farm to fork in conjunction with environmental sustainability and animal welfare).

"They don't necessarily know how to prepare and plan core foods." (Participant 7)

"I don't think they're very well informed about how food is produced – and it's not just school leavers it's general public – the processes that all food goes through... as it's grown and then as it's provided to the retailer. I don't think people know very much about at all." (Participant 12)

The issue of 'Knowledge translation for everyday food practices' (organising theme 2) was reported by some experts, particularly nutritionists, home economists and public health nutritionists. These interviewees noted that although school-leavers might be aware of some nutrition basics, their knowledge is not sufficient or useful enough to be translated into everyday practices.

"Look they get taught the basics of what's a carbohydrate; what's a protein; what's a fat – I mean I think most children would understand that but it becomes not so clear when they're eating mixed meals... So it's about how to combine, I think that's what they don't necessarily get. It tends to be very focused on 'lets talk about calcium' or 'lets talk about fruit and veggies and what's good about that' so it's not sort of brought together for the kids that are in a comprehensive manner." (Participant 6)

Many of the participants reported they thought there was a 'variable level of students' knowledge due to environmental factors' (organising theme 3), which is overall skewed toward poor knowledge of N&FS. They believed that schools, families and geographical location affected the level of N&FS knowledge across Australian school-leavers. For example it was noted that parents who have more appropriate knowledge and practices regarding food-related issues could positively affect their kids' knowledge and behaviour. Also some experts expected better knowledge and skills of food production (e.g. growing and harvesting food products) among those who are living in rural regions and belong to farmers' families. In addition some interviewees believed there were gender differences in relation to levels of nutrition knowledge (e.g. "generally on some issues females have better knowledge than males." (Participant 8)).

"I think it's variable depending on their experiences throughout school and it really struck me from doing my own research that potentially in some of the lower income areas kids may in fact have actually more skills because they might have been more likely to do home economics." (Participant 4)

"Now it's not just about teachers of course... what do their parents really know about it because parents are their teachers as well." (Participant 7)

Some of the nutritionists, dietitians and public health nutritionists had a view that 'students have poor knowledge and perception of weight management' (organising theme four). The interviewees' main concerns were when a student focused on body image issues and inappropriate methods for weight loss.

"Many of them want to lose weight – either they don't need to, or they have completely the wrong ideas." (Participant 21)

Competing roles of media and marketing and of schools in N&FS education

In this study some of the experts with stronger nutrition backgrounds (nutritionists, public health nutritionists, dietitians and home economists) referred to the important role of informative and misleading advertisements in affecting food-related awareness of Australian children and young adults. Some of the informants believed that schools are not sufficiently using their potential to educate students about food marketing.

"I think almost every kid knows that milk has calcium and I think they know them [sic] because people selling those products use it in their advertising information." (Participant 1)

Some interviewees reported that media have substantial influence over the nutrition awareness of students, perhaps to a larger extent than school education. However 'education by media' is not always appropriate since the media may present "extreme" and sometimes incorrect nutrition messages.

"I think the school leavers [are] probably more influenced by the media than what they are getting in school curriculum. I think the media sensationalises studies, and that sensationalism means that the message is not a moderate message it's an extreme message and that extreme message means that you're going to have... you're going to have contradictory findings in different studies." (Participant 11)

Discussion

This qualitative study explored the views of experienced Australian food-related experts in relation to strengths and weaknesses of Australian school-leavers' knowledge of nutrition and food systems (N&FS) broadly, which has not yet been explored in the

literature. Lack of understanding of what school-leavers know about the N&FS is an important omission, given that the importance of school-based food education programs designed to enhance healthy eating behaviours of students has been reported.^{25,26} In addition, literature has reported the importance of food systems knowledge and the need for broadening the scope of nutrition education by adding ecological, agricultural, social and economic aspects of food to health-related topics.¹⁹ In the current study, several themes emerged from the experts' views of Australian school-leavers' knowledge of N&FS.

Interviewees identified several problems they believed were associated with current N&FS education programs at schools. Participants believed that N&FS education at schools is not generally sufficient and students from different schools do not receive the same N&FS education. This is at odds with the 2014 Australian Curriculum Assessment and Reporting Authority's report related to the Australian Curriculum Health and Physical Education stating food and nutrition should be taught across the Health and Physical Education curriculum from Foundation to Year 10.²⁷ However it is not surprising as there is a lack of studies that compare the consistency and sufficiency of school-based N&FS education programs as they are provided in Australian schools. Inadequate school-based nutrition education program has been reported in a study of classroom-based fruit and vegetable preparation for primary school students in Australia. This study mentioned a lack of programs that promote fruit and vegetable intake in school setting, and concluded that involvement in the preparation of fruit and vegetables is likely to encourage children to eat and enjoy fruit and vegetables more.¹⁰ However, international studies have undertaken some exploration in relation to the adequacy of school-based nutrition education programs. For example a study of school health programs and policies across all states of the United States in 2006 found that over a one year period teachers provided about four hours of nutrition and dietary behaviours instruction at the elementary and middle school level and nearly six hours at the level of high school.²⁸ No similar study has been reported in Australia.

The lack of trained Australian schoolteachers to implement school-based N&FS education identified by this study's participants may

provide one reason why the teaching of N&FS is not sufficient or consistent. This reported lack of teacher skills is consistent with recent literature related to Australia, which stated that although teachers' preparation to teach food-related issues is critical, "currently in Australia there is no guarantee (or mandate) that pre-service teachers are taught food education within their university degree."^{29(p.87)} At present there is not sufficient evidence of directives by the departments of education or actions by tertiary institutions to support the education of schoolteachers in N&FS issues and provide regular updates of teachers' knowledge. The continuation of the basic need for teacher preparation is surprising, given the rhetoric regarding the importance of tackling childhood obesity. Clearly other topics are privileged within school curricula over the health of children. Schoolteachers' lack of efficiency in training students about food-related issues is likely to be a worldwide challenge. Stage and colleagues in a recent investigation in the United States highlighted that schoolteachers have the potential to influence eating behaviour of students extensively.³⁰ However, they found that teachers spend limited hours on nutrition education for students and barriers included insufficient professional development and lack of knowledge of complementary materials. These researchers highlighted the need to focus on improving teachers' self-efficacy to teach nutrition issues.³⁰

In the current study, insufficient levels of school-leavers' knowledge of N&FS reported by the participants is of concern, especially in relation to basic matters such as food hygiene. This view of the experts in this study is consistent with the findings of a recent study of 475 students from secondary schools and universities in Australia and the UK, which revealed generally low levels of food safety knowledge.³¹ Poor knowledge of school leavers may also translate into poor levels of adult knowledge. A 2011 study of 2,022 Australian consumers reported adults had poor knowledge of food safety.¹² It should thus not be surprising that annually in Australia there are approximately 4.1 million domestically-based cases of foodborne gastroenteritis.³²

In the current study the experts also reported that school-leavers did not have an understanding of nutritional requirements in early childhood. This knowledge was identified necessary as some of the school-

leavers might be parents in the near future. Parents have responsibility for their children's dietary behaviours and parents have been a focus of public health interventions that have aimed to improve children's dietary habits.³³ The perception of participants in this study of a lack of knowledge about nutritional requirements in early childhood is consistent with an investigation of 439 Australian parents of children under five regarding knowledge and acceptance of infant and young children's public health feeding recommendations. That study concluded that "awareness and acceptance of infant feeding recommendations in Australia is poor."^{34(p. 31)}

Not all of the identified areas of poor N&FS knowledge in this study have been assessed previously in Australian studies. This study has highlighted a perceived lack of students' knowledge of the process of food production from farm to fork, as well as issues relating to environmental sustainability and animal welfare. The importance of knowledge of these food systems related topics could be defined in the context of the need for citizens to improve their food choices toward more ecologically friendly and sustainably produced food products, which is supportive of a sustainable food supply,³⁵ welfare of farm animals,²¹ and sustainability of the environment.¹⁸ Such knowledge gaps identified in this study could be explored further in future research and suggest neglected areas of N&FS education at schools. Some experts also believed there was variability in the level of N&FS knowledge among Australian school-leavers which may be the result of wider socioenvironmental factors including: family (parents' knowledge and practices), food education programs offered within attended schools, and geographical location (urban and rural). These factors may influence the level of knowledge among school-leavers and are reflected separately in Australian and international food-related knowledge studies. An Australian study of consumers' food safety knowledge indicated poor safety knowledge was negatively associated with health education at school.¹² International studies have also reported positive effects of school-based nutrition and food safety education on students' knowledge and behaviour.^{36,37} In addition, the important role of parents' knowledge and behaviour on their children's understanding and practices of N&FS related issues identified in the current study has also been reported in international studies

on the (positive) influence of parents as role models for healthy eating behaviour among teenagers³⁸ and middle school students.³⁹ This reinforces the need to consider nutrition education in a wider context than just what may or may not occur in schools and the need to explore the potential to promote important N&FS topics within the supportive environment of the family.

Participants in the current study also believed that female school leavers had overall higher levels of nutrition knowledge compared to male school leavers. This is consistent with a quantitative study of demographic variation in levels of nutrition knowledge in the Australian community, which identified overall higher nutrition knowledge scores for female Australian participants.¹⁴ Also international studies have identified higher knowledge scores of nutrition among female participants compared to males.^{40,41} This might suggest the need to explore strategies that effectively engage male students in N&FS education programs at schools.

Several of the participants identified the potentially substantial effects of media on students' and school-leavers' awareness of food and nutrition issues. There were a few experts who believed that media could be even more effective than the school setting. At the same time they expressed their concerns in relation to the media's immoderate food messages. This is consistent with a study of general nutrition knowledge and the demographic variation among Australian community by Hendrie and colleagues that highlighted the mass media are key sources of nutrition information and misinformation in the community.¹⁴ About a decade ago these investigators reported that media in Australia had favoured low-carbohydrate, high-protein diets and acknowledged that such information was likely to be misleading among the public. Media attention in Australia has created doubt about the healthiness of foods rich in carbohydrate, which is not a message consistent with Australian dietary guidelines.¹⁴ At the same time, Australian literature has highlighted that substantial outcomes can be achieved with reasonably small budgets for promotion of nutrition recommendations through mass media.⁴² The successful outcomes of "Go for 2&5" campaign in Australia, which aimed to increase fruit and vegetable consumption, and constructive effects of mass media advertising through television, radio, press, etc, is an appropriate

example.⁴³ Future research of school leavers' knowledge of N&FS issues might address the relative influence of school based education and messages provided by mass media.

Limitations

An identified limitation of this study was that it focused on food-related experts' views regarding current N&FS knowledge of school-leavers and did not assess school-leavers' actual knowledge and skills. Further research is required to assess knowledge of wide range of important nutrition and food systems issues. Another limitation was that pre-selected health teachers did not accept our invitation to participate in this study. Thus, this group, who are in direct contact with students at schools, was not included among our interviewees. In addition, the participants, while expert in their professional field, may have varying familiarity with school-leavers' levels of knowledge.

Conclusion

Study findings indicated that there are major structural and curriculum-based issues impacting current N&FS education programs in Australian schools. The structural problems related to inconsistent and insufficient N&FS educational programs that are currently provided at schools, together with lack of appropriately trained school teachers. The findings have highlighted perceived key gaps in current N&FS knowledge of Australian school-leavers. Overall, participants assumed that Australian school-leavers' knowledge of N&FS is not sufficient and translatable for everyday practices. The findings suggested that current knowledge of school-leavers is affected by some environmental factors, including the home environment and the influence of media and marketing systems. The study results also suggest potential neglected components of N&FS education within current school curricula. These findings provide important insights for N&FS curriculum developers and education policy makers to improve school-based N&FS education programs in Australia.

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Appendix 3: Chapter 6 published as journal article



Article

Professionals' Recommended Strategies to Improve Australian Adolescents' Knowledge of Nutrition and Food Systems

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Abstract: Background: Education and policy measures within schools are valuable strategies to promote health. This study explored views of experienced food-related educators, researchers and policy-makers regarding their recommended strategies to improve Australian adolescents' knowledge of nutrition and food systems (N&FS). Methods: Semi-structured interviews were conducted with twenty-one experienced food-related experts from across Australia. Interviews were conducted either by telephone or face-to-face. Recorded interviews were transcribed verbatim and analyzed thematically. Results: Five central themes and five sub-themes were identified from food professionals' suggestions for best strategies to improve adolescents' knowledge of N&FS. The central themes included: (1) specific improvements in schools' core curricula; (2) pre-service and in-service training of school teachers about N&FS; (3) training students to develop a critical mind about N&FS issues; (4) multidisciplinary collaborations to improve school-based N&FS education; and (5) a supportive N&FS education environment for students. Conclusion and implication: These findings provide a guide for curriculum developers, educational policy developers, and food educators to incorporate the suggested N&FS strategies into Australian education programs in order to improve Australian adolescents' knowledge and skills of N&FS issues. The results of this investigation also may assist the development of international N&FS curricula guides.

Keywords: education strategies; nutrition; food systems; knowledge; Australian adolescents

1. Introduction

Education and policy measures within school settings are valuable approaches to improve health. Schools offer the most effective and efficient environment to reach a large proportion of the community including young people, families, school staff and community members [1]. The positive effects of school-based food and nutrition education programs to improve students' knowledge [2–7], attitudes [5,8], preferences [5,9], behavior [3,4,7,8] and self-efficacy [5,10] are reported in literature from around the world. The ultimate purpose of school-based nutrition education initiatives is to support reductions in the burdens of nutrition-related health problems. Unfortunately, the prevalence of obesity among children and adolescents has become a critical global health challenge [7] and poor dietary behaviors are the leading contributor to burden of disease. In high-income countries changes in dietary intakes have resulted in over-consumption of energy while diet quality remains poor [11] and in middle and low-income countries there has been a dietary transition toward increased consumption of refined carbohydrates, added sugars and fats [12].

Research indicates that healthy eating is associated with an increase in quality of life, life expectancy and decreases in nutrition-related chronic diseases such as cardiovascular disease, cancer

and diabetes [13]. Eating habits and preferences are shaped from childhood and gradually become part of an individual's routine [14]. One important strategy to assist youth to appreciate and develop healthy dietary behaviors is to offer nutrition education programs and supportive food environment in schools [13].

In addition to traditional nutrition education for students, which is primarily designed to foster healthy dietary behaviors, there also is a need to improve students' knowledge of food systems and their capacities to think critically about the wider impacts of their food choices [15]. Food systems are defined as "the process of food production, distribution, preparation, and preservation; food use and consumption; the recycling and disposal of food wastes; and the systems that support this process including marketing, transportation, storage, and government services" [15]. Food production and consumption connects people and the environment [16]. It is important to promote among the public appropriate food choices that are supportive of sustaining natural resources, the environment and food systems, and knowledge of food systems has been recommended [15].

For decades experts have recommended food-related educational programs be incorporated into school curricula and delivered to enhance children's understandings [17]. School-based education programs should teach students not only the required, broadly-based nutrition and food systems (N&FS) knowledge, but also the necessary skills such as making appropriate food choices, food preparation and food storage [17–19]. Nutrition education investigators have raised the need to use a wide range of teaching methods for school-based nutrition education programs [18,19]. Selected methods need to be based on learning objectives "from classroom discussions, work-sheets and keeping food records; to shopping exercises, tasting, creating or drama" [18]. In addition, the World Health Organization's Information Series on School Health recommended a combination of various teaching methods for students to improve their knowledge, beliefs and skills [20].

Specific learning approaches to improve students' nutrition knowledge or dietary behaviors are separately explored and recommended in the literature, such as integrating nutrition topics with other school subjects [6], food preparation and cooking activities [21,22], school gardens [9,23], and game-based innovations [24,25]. Carraway-Stage and colleagues also suggest that in order to increase students' exposure to nutrition-related information in schools it is necessary to integrate nutrition topics within other subjects (such as science) [6].

Overall very few studies have focused on the identification of a full range of effective strategies to improve students' knowledge of nutrition and food systems during formal schooling [19,26]. One study, a systematic review and meta-analysis of teaching approaches to promote healthy eating among elementary school students [26], identified cross-curricular strategies and experiential learning methods as the most effective ways to improve children's dietary behaviors [26].

In previous work we have reported on an investigation of experts' views of best strategies to improve Iranian adolescents' knowledge of nutrition and food systems [19]. That study identified the need for a multi-levelled, systematic approach that included three key components of: policy; the process of education; and supportive environments. A wide range of strategies was suggested to improve adolescents knowledge of N&FS. Some of the identified strategies were: training school teachers, increasing skill-based and skill developing education programs at schools, developing critical thinking among students regarding food-related issues, and modifying inaccurate beliefs and traditions among Iranian students [19].

To the best of our knowledge, there is a paucity of research into efficient and effective methods to improve Australian students' knowledge of N&FS during formal schooling. Therefore, this study aimed to develop a broad guide for strategies to improve Australian adolescents knowledge of nutrition and food systems.

2. Materials and Methods

The study interviewed highly experienced food and education professionals who were engaged in various nutrition and food systems (N&FS) fields, including: home economists, nutritionists, dietitians,

public health nutritionists, food scientists, environmental scientists and veterinary physicians from four States (New South Wales, Victoria, Queensland and Western Australia) and one Territory (Australian Capital Territory) of Australia. Purposive sampling method [27] was employed to select an appropriate group of prominent professionals from these fields. The inclusion criteria were: experienced academics from top ranked universities of Australia with long time contributions to food-related education programs and relevant research; acknowledged policymakers who were involved in community nutrition education programs; and experts with key roles in professional governmental and non-governmental organizations. To select appropriate academics, the first and second authors performed a thorough web-based investigation of staff profiles from all relevant schools or departments from major universities in Australia. Potential participants were selected who were experienced in young Australians' food education programs or those who were involved in Australian food and nutrition education research. A similar web-based search was performed to identify a group of appropriate participants from Australian organizations who were active in nutrition education, consumer welfare, animal welfare and environmental sustainability. Further searches were performed in 'Research gate' and 'LinkedIn'. The investigators developed a list of forty eligible experts. The objective was to stop recruitment once data saturation had occurred [28]. Ethics approval was granted from the Human Research Ethics Committee (Health and Medical) at the University of Wollongong (Approval No: HE12/277).

Sanaz Sadegholvad (SS) and Heather Yeatman (HY) invited potential participants via email for face-to-face or telephone-based interviews. The experts who agreed to participate were issued with the participant information sheet, consent form and the interview questions. Interview dates/times and location were arranged via email. Before commencing each interview, participants provided an informed written and/or audio recorded verbal consent.

SS conducted semi-structured interviews with each of the participants who participated in this study. Semi-structured interviewing methods [29] provided the opportunity for interviewees to express and expand their views on the best strategies to improve adolescents' knowledge of N&FS. Interview questions were developed by the authors and were confirmed with a panel of four experienced academics with food education and research backgrounds the University of Wollongong. Three key open-ended questions were used for all interviews:

1. What are the best strategies to increase adolescents' knowledge of nutrition and food systems?
2. What do you think could be done differently to increase their knowledge?
3. Do you have other suggestions for school-based N&FS education programs?

All the interviews were audio-recorded. The interviews were transcribed verbatim by a professional audio transcriber and reviewed and checked by the first author. Inductive thematic analysis [30,31] was conducted using manual coding and the Nvivo 10 software program. In an inductive thematic analysis the researchers do not try to code the data to fit a pre-established coding frame or the investigators' analytic perceptions. This method of analysis is data driven [30].

Steps described by Baum and Clerk [30], and Vasmoradi and colleagues [31] guided the thematic analysis. Initially, the first author read and reviewed all the transcripts several times to become familiar with the collected data. Initial codes were generated from the features of the entire data set. Potential themes were generated from the coded data by the first author and were reviewed, re-reviewed and named by the first and second investigators. The reviews of transcripts continued until no new themes emerged from the entire data set. All authors reached consensus in relation to the labeled themes for the final report. Finally, a brief report of identified themes and details of each theme and sample quotes were developed to present the findings in a clear strategic manner [30,31].

3. Results

Data collection ended after interviewing twenty-one experts, when data saturation had occurred. All interviewees were experienced educators and/or prominent researchers from universities and/or

governmental and non-governmental organizations. In addition some of the interviewees were involved in policymaking. Interviewees included three public health nutritionists, one public health expert, four dietitians, four nutritionists, four home economists, two food scientists, two veterinary physicians (experts in animal-sourced food production and animal welfare issues) and one environmental scientist.

The recommended strategies to improve adolescents' N&FS knowledge were organized into five central themes and five sub-themes described below. Identified themes are shown in Figure 1.

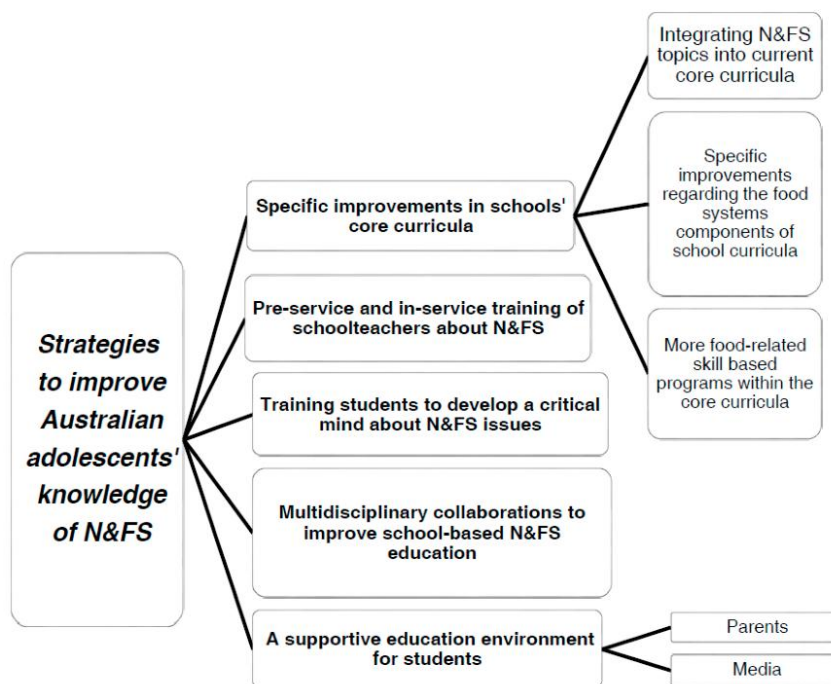


Figure 1. Professionals' recommended strategies to improve Australian adolescents' knowledge of nutrition and food systems (N&FS).

The interviewees from different groups of experts recommended three main strategies to improve the current core curricula of Australian schools. The first suggestion was to integrate N&FS topics into current core curricula. The second strategy was specific improvements in relation to the food systems components of school curricula. The third strategy was to increase food skills development within the core curricula. These three strategies are described separately below.

There was consensus across the different groups of interviewees that N&FS topics need to be integrated into current core curricula such as Science, Geography, History, and English Literature. Some interviewees noted that there was "very little chance" to allocate a separate subject for N&FS topics within school curricula. They stated that it was not necessary to have a separate subject for N&FS lessons because N&FS topics can be easily integrated into current core subjects. They also believed the integration of important N&FS topics within current subjects provided the opportunity for all students from across the Australia to receive an appropriate level of food-related education regardless of the schools they attend or subjects studied.

“There is very little chance of getting a new solo called nutrition subject and that is not necessary . . . Curriculum at schools can do this not by having a separate nutrition class, but integrating nutrition and food systems issues into the normal science curriculum . . . into Biological Sciences, Geography, History, English Literature and other . . . for example English teachers can get the students to write about food security questions . . . get them in geography classes to write about water and food distribution, in history classes they can look at how food supply in Australia has changed or somewhere else has been changed since world war two” (interviewee #21).

Most of the interviewees shared a common belief about the need for specific improvements in relation to the food systems components of school curricula, stating that the major focus of current school and community-based food education programs are to improve health outcomes. However, some experts including public health nutritionists, nutritionists, dietitians, veterinary physicians and the environmental scientist emphasized the need to educate students about food production systems and more generally about food from farm to fork, in relation to both agriculture and animal-based food products. In addition several experts also believed some animal welfare and environmental sustainability information should be incorporated into lessons addressing food production systems.

“I think that it is important to provide students with opportunities to gain an understanding and perhaps through visits to companies and projects and other things where they actually investigate how food is grown, how food is processed, how it gets to the consumer is an important part of learning about their life support systems” (interviewee #10).

“They need to know about what is a sustainable healthy food basket . . . a basket of goods needs meet some nutrition requirements and anything over that is waste. . . . they need to know about not using packaging They need to know about foods that they choose and sustainable food system and sustainable environment” (interviewee #7).

The home economists and most of the interviewees with nutrition backgrounds (public health nutritionists, nutritionists and dietitians) reported that food skill programs like shopping, cooking, storing foods and gardening needed to be one part of the core curricula to assist adolescents to improve their skills for everyday life. These experts focused on the importance of healthy cooking and food preparation courses for all students from primary school until school-leaving age.

“First of all it is the shopping, it’s the making a shopping list, making a healthy meal, knowing what to have in your pantry and refrigerator, seasonal ingredients so that’s the food literacy skills then the food preparation the cooking skills” (interviewee #6).

3.1. Pre-Service and In-Service Training of Schoolteachers about N&FS

The home economists and some nutritionists, public health nutritionists and dietitians frequently spoke of the critical need for training and re-training of school teachers about important N&FS topics to enable them to transfer accurate and updated information to students. Some of these interviewees noted the enrichment of school curricula with essential N&FS topics should be supported by adequate N&FS pre- and in-service training for schoolteachers.

“Teachers need to be better prepared and not assume they can teach it from no background” (interviewee #6).

3.2. Training Students to Develop a Critical Mind about N&FS Issues

Two interviewees involved in policy-making and food-related educators identified that students need to develop a broader view and a critical mind about food. These experts stated that students need to find the ability to think and discuss food-related issues in a multidimensional context. It was reported that students needed to achieve a general understating of social, political, environmental,

economic and cultural aspects that are associated with food consumption, food production and food choices. Some interviewees believed students needed to learn to identify and search appropriate N&FS information sources and should learn basic research skills.

“Integrate political issues, issues of public interest, encourage and teach them to think critically and ask them to write critical argument. They need to recognize how social, economic and political determinants influence our food consumption” (interviewee #21).

3.3. Multidisciplinary Collaborations to Improve School-Based N&FS Education

Some interviewees recognized the challenges associated with the broad and multi-disciplinary nature of N&FS topics. They reported that it was necessary to create further collaborations among schools, Departments of Education and universities (and experienced experts from different food-related disciplines) to improve N&FS education programs in schools. This was considered necessary to ensure: the identification of all essential N&FS components of school curricula; the provision of regular updates relating to the N&FS components of school curricula; the provision of appropriate education and training for schoolteachers about N&FS topics; and the planning of food-related education programs for students.

“We need to engage different educationalists to find how they can use food-related issues into current curriculum. I think we need to make sure that university level educators are having input into the school curriculum. I think, it should be cutting edge material that goes into that” (interviewee #8).

3.4. A Supportive Education Environment for Students

Interviewees from the different groups of experts stated that parents and the media need to create a more supportive environment to facilitate and support the process of educating students about N&FS. The experts' suggestions to improve the roles of parents and media are described separately below.

Parents: some of the interviewees believed it was necessary to educate parents about N&FS issues in order to create a more supportive environment at home, which they considered was an important education setting for children. The purpose was to facilitate appropriate role models and to prepare well-informed food educators for the home setting. Some experts suggested changes in relation to students' knowledge, attitude and behaviour about food-related issues are unlikely to occur without proper parental education. Building parents' knowledge and skills was identified as a solution to overcome time constraints and overcrowded school curriculum.

“The parents, the school and the students, and teachers all are working together. That's really important because we could be teaching students but we also need to ensure that the parents are also involved so that it's always a team work approach. That's important, a whole school approach so that what we're teaching in the schools is also being underpinned and, and supported at home” (interviewee #15).

Media: some of the interviewees from different groups of experts expressed the need for more educational food-related programs in the media rather than just food related entertainment. Some experts referred to popular cooking television (TV) shows in Australia which promote cooking and eating practices that are not consistent with the Australian Dietary Guidelines' recommendations. In addition some experts believed junk food advertising during children's programming on Australian TV distorts children's knowledge of appropriate eating habits. A further suggestion was for mass media to support public discourse by acknowledged food related experts.

“If there was a master chef that focused on healthy eating I think it would be a wonderful initiative. I think all the cooking shows are probably doing more damage to our food supply than anything else because there is no regard to nutrition at all. There just, you

know the standard thing of butter and lots of salt, lots of dairy fat, lots of everything that I would regard as something as a special occasion so it's kind of party food rather than everyday food. So a sort of Jamie Oliver in Australia would be a really good outcome." (interviewee #4).

4. Discussion

This study explored experienced food professionals' recommendations of strategies to improve Australian adolescents' knowledge of nutrition and food systems (N&FS). Experts' suggestions addressed five key issues including: improvements in schools' core curricula; the importance of training school teachers about N&FS; training students to think more broadly and critically about N&FS issues; multidisciplinary collaborations to improve N&FS education programs in schools; and development of a supportive education environment for students by parents and media.

One strategy to improve the schools' core curricula was integrating N&FS topics into current core subjects. This finding is consistent with overseas studies that identified or made reference to successful interventions that integrated nutrition lessons with other subjects such as science, language and mathematics at schools [1,6,32]. An intervention study in the United States (US) involved the integration of nutrition within other school subjects over the course of one year [6]. The findings identified the positive influence of integrative food-based curriculum on students' nutrition knowledge in the intervention group compared to the comparison group.

The potential positive effects of an integrative curriculum on students' knowledge was identified in the current study but to the best of our knowledge there has not been reports of any studies that have investigated the effects and practicality of a separate subject for N&FS topics. Thus it is not possible at this time for food educators and researchers to compare the relative effectiveness of an integrative N&FS-based curriculum versus a separate subject for N&FS.

Another suggested strategy to improve school curricula was more skill-based programs within the core curricula from primary school to high school. The importance of food skill programs has been supported by studies that identified the positive effects of school-based gardening, or food preparation and cooking interventions on children and adolescents' dietary behavior [9,22,23,33]. A recent systematic review and meta-analysis of teaching approaches to improve healthy dietary behavior in primary school children [26], identified that 'experiential learning approaches' such as gardening, food preparation and cooking had the greatest effects compared to other approaches on increased knowledge of nutrition, reduced energy intake and increased intake and preference of fruits and vegetables [26].

The interviewees in this investigation believed there was a need for specific improvements in education about food systems in Australian schools. Unfortunately, in Australia and internationally, food systems education programs have not been considered to be necessary, essential long-term learning objectives. In contrast, food systems investigators have highlighted the importance of students' food systems knowledge and the impacts of people's food choices on the sustainability of the environment and the food system [15,19,34]. The connection between people's food choices and food systems has been raised in studies focusing on the exploration of consumers' choices in regard to: local foods [35], organic foods [16,36] animal friendly food products [37] and environmentally friendly food products [36,38]. Incorporating more food system topics within current school lessons may support adolescents' informed food choices by not only addressing health issues but also factors such as environmental and food system sustainability, farm animal welfare, and welfare of local producers and farmers.

The current study has identified the need for training school teachers about important N&FS topics. No recent studies have reported on Australian schoolteachers' knowledge of N&FS issues. More than one decade ago a study in Australia explored trainee home economics and physical education teachers' knowledge, attitudes, and behaviors related to weight management, body image and eating disorders [39]. The findings revealed that while teachers had not received nutrition

education, they did recommend diets to overweight teenagers despite their lack of knowledge in relation to adolescent nutritional requirements, weight management and fad diets. In addition the study reported uninformed views about eating disorders and use of inappropriate weight loss methods was identified among the studied teachers [39]. A recent study of 181 US teachers, who were responsible for the nutrition education of one million children from lower socio-economic backgrounds revealed only 3% of teachers answered four out of five nutrition knowledge questions accurately, 54% agreed that it was difficult to distinguish which nutrition information was reliable, and only 9% of teachers reported they followed healthy dietary behaviors. This study highlighted the importance of nutrition education for teachers to enable them to teach students about important nutrition issues and to improve their own dietary behaviors [40].

Overall, despite the lack of recent literature identifying schoolteachers' knowledge of broad range of N&Fs issues, nutrition education researchers have confirmed the importance of equipping schoolteachers with adequate knowledge of nutrition to improve their willingness and confidence to teach nutrition-related lessons [41]. In addition, Worsley and colleagues in a study of food knowledge related to Australia suggested that home economists programs may influence students' long-term food knowledge [42]. Development of specific strategies to target schoolteachers' education needs may also be necessary. A recent cluster-randomized trial study of 20 school teachers in rural China [43] found that a comprehensive school-based nutrition program did not improve teachers' knowledge, behavior and attitudes about nutrition. Thus teachers' involvement in interventions that primarily target students may not be sufficient to improve their own N&FS knowledge and skills.

The interviewees involved in the current study expressed the need for media to create a supportive education environment for students. Nutrition education researchers have highlighted the important role of television in distributing nutrition education messages, for example via broadcasted food advertisements [44]. However, literature related to Australia has shown a lack of a supportive education environment of Australian television that has allocated most of the food advertisements to non-core foods (63%) [45]. The food professionals in the current investigation raised concerns about popular cooking TV shows in Australia (e.g., Masterchef), which portrayed dietary and food practices not consistent with Australian Dietary Guidelines. However, such views may be purely personal and not reflective of actual influence of such television programs. A recent Australian study identified that adult participants did not consider celebrity chefs and TV cooking shows affected their dietary intakes [46]. Young people are also high users of social media and Australian studies have shown the effects of social media on particular dietary behaviors, such as risky alcohol consumption [47]. At the same time, nutrition educators have underscored the positive potential of social media as a low-cost, quick and direct way to communicate nutrition messages [48].

In addition to media, the interviewees of current study expressed the need for parents to create a supportive education environment for their children. The importance of this issue is revealed by Australian and overseas studies, which have reported the influence of parents on their children's dietary behavior [49–52]. For example, an Australian study found that parents influence young children's eating habits, but often lacked the required nutrition knowledge and food skills to improve their children's dietary behavior [49]. While this may be a useful suggestion from a school's perspective, a more holistic approach to N&FS education, it may be unrealistic. Parents may not consider they need to be 'educated' about N&FS issues. Parents also may not believe they have an education role with regard to their children's N&FS knowledge, which they may consider to be the school's responsibility. Further research needs to address this issue.

Not all identified N&FS education strategies identified in current study have been previously reported in the literature. For example, the experts in the current study believed there is a need to develop critical thinking in students in relation to N&FS issues. However, development of critical thinking in students in relation to food consumption, food choices, food production issues or more broadly N&FS issues has not been well addressed in the existing literature. Another finding of this study was the importance of increasing multidisciplinary collaborations of schools, Departments of

Education and universities. Such collaborations were identified as necessary to improve the quality and efficiency of N&FS education programs offered to students and schoolteachers.

5. Conclusions

The findings of this study provide important points for consideration to develop efficient and effective strategies to improve Australian adolescents' knowledge of N&FS. The five key components included: improvements in schools' core curricula; training schoolteachers about important N&FS topics; developing critical minds about N&FS issues; multidisciplinary actions to improve N&FS education programs in schools; and improving the positive involvements of parents and media to create a supportive education environment for students. This information will assist curriculum developers, education policy developers, and food-related educators in their endeavors to improve adolescents' knowledge and skills of N&FS issues and, in turn, to address key public health priorities in Australia.

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Essential nutrition and food systems components for school curricula; views from experts in Iran

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Essential Nutrition and Food Systems Components for School Curricula; Views from Experts in Iran

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Abstract

Background: This study aimed to investigate food experts' views on important nutrition and food systems knowledge issues for education purposes at schools in Iran.

Methods: In 2012, semi-structured, face-to-face or telephone interviews were conducted with twenty-eight acknowledged Iranian experts in food and nutrition fields. Participants were selected from four major provinces in Iran (Tehran, Isfahan, Fars and Gilan). Open-ended interview questions were used to identify nutrition and food systems knowledge issues, which experts considered as important to be included in school education programs. Qualitative interviews were analyzed thematically using NVivo.

Results: A framework of knowledge that would assist Iranian students and school-leavers to make informed decisions in food-related areas was developed, comprising five major clusters and several sub-clusters. Major knowledge clusters included nutrition basics; food production; every day food-related practices; prevalent nutritional health problems in Iran and improvement of students' ethical attitudes in the food domain.

Conclusion: These findings provide a guide to curriculum developers and policy makers to assess current education curricula in order to optimize students' knowledge of nutrition and food systems.

Keywords: Nutrition, Food systems, Knowledge, Education, School, Iran

Introduction

The literature across several nations, including Europe (1), United States (2), and Iran (3) demonstrate the potential of schools to deliver important food and nutrition messages is yet to be reached. The importance of food and nutrition education is discussed in the literature (4), but to date, there is little published research identifying what students need to learn about nutrition and food systems more broadly.

Globally, different aspects of nutrition and food systems knowledge required for consumers to make informed food choices or to improve their dietary behaviors have been separately documented, covering a wide range of issues, such as

food safety (5), use of food labels (6), cooking skills (7), and other food and nutrition topics.

Several assessment tools have been developed to measure particular sub-components of nutrition or food system knowledge such as dietary recommendations, food sources of nutrients, daily food selections, nutrition-related health problems (8), food system sectors, food sources, sustainability, local foods and hunger (9).

A major gap in the literature to date includes investigation of a broad range of important nutrition and food systems knowledge issues within one study. Consequently, there is little strategic guidance for food educators, education curriculum developers, and policy makers against which to

assess and build comprehensive education programs. This research addresses this issue.

The “new nutrition science” (NNS) takes a broad view of nutrition and incorporates various food-related issues from different food and nutrition disciplines. The NNS reflects biological, social and environmental aspects of nutrition science that affect food systems and people’s food decision-making (10). However, this multidimensional perspective has been neglected to date in the food and nutrition knowledge literature.

Food and nutrition knowledge literature related to Iran has three major focuses. First, studies which assess a target population’s knowledge of a particular nutrition and food-related issues such as food labels (11), food groups (12), and food safety (13). Second, studies which raise the importance of nutrition education for particular health-related outcomes, for example preventing obesity (14), osteoporosis (15) and cardiovascular diseases (16). Third, studies that investigate aspects of nutrition knowledge associated with balanced, healthy eating habits for particular populations. For example, research directed attention to nutrition during pregnancy (17), adolescents’ knowledge of healthy dietary behavior (18), and knowledge for healthy eating among college athletes (19). However, there is not a study that identifies a broad range of nutrition and food systems issues essential for Iranians to know or a study that assesses Iranian’s knowledge of a wide range of food-related issues.

Knowledge, the focus of this investigation, is a complex concept (20). The incorporation of the epistemology of knowledge framework will assist in understanding the study findings. This study employed a holistic framework of knowledge developed by Yang (20) based on three facets of knowledge 1) explicit, 2) implicit and 3) emancipatory, reflecting the different processes of knowing in adult learning. The explicit facet represents scientific aspects; the implicit facet reflects practice, and the emancipatory facet is carried by values and ethics (20). This approach is consistent with the multidimensional nature of the NNS, whose dimensions of knowledge cover scientific (explicit) aspects of nutrition; food and

nutrition-related skills (implicit); and cultural and values-based (emancipatory) factors.

Methods

Participants

Participants were drawn from various food-related fields to ensure the research incorporated expert views on the different dimensions of nutrition and food system issues consistent with the New Nutrition Science (NNS). A mix of Iranian experts was identified for recruitment, including four public health nutritionists, four nutritionists, four dietitians, four food scientists, two environmental scientists, two veterinary physicians, two agriculture scientists and four high school teachers (health teachers and home economics teachers) across the country. Participants were recruited through purposive sampling and snowballing. Experts were considered eligible for inclusion if they were acknowledged academics in top-ranked universities, practitioners who had key roles in professional governmental and non-governmental organizations, and recognized experts in private practice. Experts were invited to participate in person or by telephone. The dates and venues for the interviews were then arranged and participants were given the interview questions, participant information sheet and consent form (all in Farsi) prior to the interviews.

Ethics approval was received from the Human Research Ethics Committee (Health and Medical) of the University of Wollongong. Anonymity was assured and participants’ identities were replaced with alphabetical letters and numbers on any potentially identifying materials such as notes, transcripts, and recordings.

Data Collection

Open-ended interview questions were developed by the study authors and reviewed by an academic review panel. Questions explored the experts’ attitudes regarding important nutrition and food systems knowledge issues for Iranian school-leavers. Semi-structured face-to-face or telephone interviews were conducted with invited experts

between September and Dec 2012. Interviews lasted between 15-120 min.

All interviews were conducted in Farsi by the first author for whom Farsi is her first language. Interviews were recorded using two recording devices to ensure a backup. The first author transcribed the interviews in Farsi and then translated them into English for analysis. Examples of the interview questions are:

- What do you consider the average school-leaver should broadly know about nutrition and food systems? (What do students need to learn before school-leaving age?)
- If we try to outline the most important issues to be included in the education curriculum, what do you think are most important? Why?
- What food-related skills do you think students need to develop?

Data Analysis

English translations of the interview transcripts were uploaded to NVivo (QSR NVivo 10) for analysis and were subsequently coded. The constant comparative method was used to identify emerging themes (21). In this study, the “step by step” strategy for constant comparative method was used (22). The first three steps of this approach relevant to our study data included: 1) comparison within one interview to develop categories and to label them with suitable codes; 2) comparison between interviews that belong to the identical group of experts who share quite similar experience (e.g. group of nutritionists, group of food scientists); and 3) comparison between interviews from different groups to develop and deepen the information and “complete the picture” (22). The coding was undertaken by two of the authors in an iterative manner and some manual coding also was undertaken as measures to confirm reliability of the coding process.

Results

Sample Characteristics

The final list of participants, N=28, included five public health nutritionists, five nutritionists, five dietitians, four food scientists, two environmental

scientists, two veterinary physicians, one agriculture scientist and four high school teachers (one health teacher, one home economics’ teacher, one agriculture science teacher and one food science teacher) from Tehran, Fars, Isfahan and Gilan, Iran. They were all experienced in food-related education programs and/or food-related policymaking and/ or active in food-related research programs.

There were similarities amongst the findings within the same group of experts (e.g. environmental scientists, food scientists). Interviewing a range of food-related experts provided multiple perspectives on nutrition and food systems knowledge and overcame the potential limitation of interview data reporting selective issues reflecting the views of one or two discipline areas.

Participants believed nutrition and food systems knowledge was necessary for Iranian school-leavers because food-related issues were embedded within people’s daily lives. They highlighted the need for a strategic, coherent, continuous and long-term teaching program from the earliest stages within the formal education system until school-leaving age. Other significant issues raised by almost all the participants was the need to focus on food knowledge issues helpful for “routine life” or information for “everyday use” and “practical skills”, and the importance of avoiding “professional” and “technical” information in education programs.

Important areas of nutrition and food systems knowledge

Five major nutrition and food systems knowledge clusters and several sub-clusters were identified, as depicted in Fig. 1. The major knowledge clusters were nutrition basics, food production, every day food-related practices, prevalent nutrition-related health problems in Iran, and ethical attitudes in the food domain. These clusters are presented in the following sections.

1-Knowledge of nutrition basics

This aspect of knowledge, mentioned by most of the participants, included key nutrition recommendations within the national policy guidelines, including the Dietary Guidelines, Food Pyramid and Thrifty Food Basket designed for Iranians.

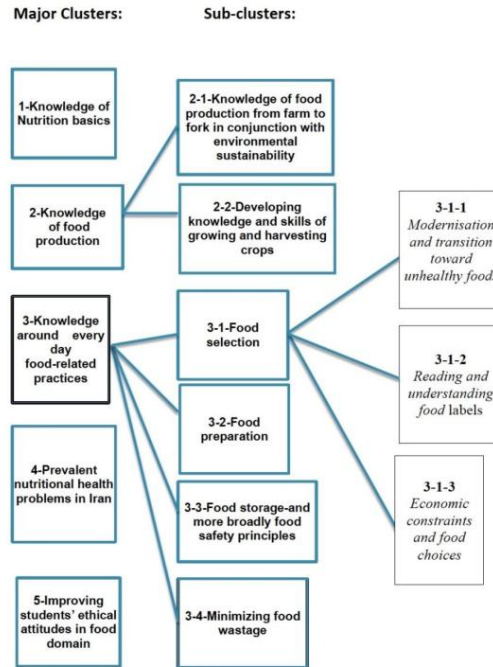


Fig. 1: Respondents' views of important nutrition and food systems knowledge issues for Iranian school-leavers

The major focus was on knowledge of the five food groups; nutritious alternatives within each food group; keeping diversity and balance in consumption of foods from all major food groups, and daily consumption of breakfast. It was identified important to acknowledge and be familiar with the nutrition needs of high-risk population groups, particularly pregnant women, breastfeeding women and children under five, mainly in the context that “future school-leavers might one day become “pregnant” or “a parent”.

2- Knowledge of food production

It was important to know “where foods come from” and “how foods are produced and provided”. Major focuses were on: a) food production from farm to fork in conjunction with environmental sustainability and b) knowledge and skills for growing crops

2-1 Food production from farm to fork in conjunction with environmental sustainability

Participants raised the need for awareness of food production procedures in relation to different food groups (e.g. dairy products and cereal foods) from farm to fork. At the same time, they raised the need to avoid “unnecessary”, “theoretical”, “technical” and “professional” information.

“For example, school-leavers need to be familiar with milking cows in livestock farm, ways of storing milk, transporting milk to the factory, pasteurising milk, and producing yogurt, cheese, etc., also transferring the products to the market and issues around milk adulteration like adding water or starch to it” (10-R).

Environmental scientists and some public health nutritionists emphasized knowledge of the negative effects on the environment of inappropriate food production systems. Three issues were identified.

Firstly, the significant use of natural resources for producing animal-based proteins compared to plant foods. Secondly, the negative effects of inappropriate agricultural practices on the environment through inappropriate management and use of chemical fertilizers and pesticides. Thirdly, they raised the harmful environmental effects caused by intensive livestock production systems, including increasing greenhouse gas emissions and overuse and damage to natural resources.

“We should highlight the importance of protecting our environment because school-leavers should not only care about what they eat but also about the environment that we are living in - the land, soil, and air.” (8-M)

2-2 Developing knowledge and skills of growing and harvesting crops

A few participants believed students and school leavers, particularly rural students, need some knowledge of growing and harvesting. They asserted that equipping students with this knowledge might positively affect their attitudes, knowledge, and skills regarding gardening and farm-related occupations.

“In Iran, we have proper agricultural lands and it is needed to add agriculture topics within school curriculum ... Then they might find enough self-esteem to start farm-related jobs” (11-SH).

3- Knowledge around everyday food practices

Each of the study participants mentioned a few knowledge issues related to everyday food practices, including knowledge of food selection, food preparation, food storage (more broadly food safety), and minimizing food wastage.

“It is very important for school-leavers to have some knowledge about food labeling, food storage, and food preparation and cooking” (19-J).

“We haven’t done considerable work on food selection knowledge domain in our country, not for adults, nor for kids. This is a gap in Iran and we need to work on it.” 18-A).

3-1 Food selection

The focuses of knowledge for food selection were on: a) modernization and food transition

toward unhealthy foods; b) reading and understanding food labels, and c) economic constraints and food choices

3-1-1 Modernization and food transition toward unhealthy foods

Participants raised the significant role of globalization and modernization in transition toward the consumption of “tasty” and “convenient” foods. This was particularly important as they expressed the view that shift toward consumption of “junk foods”, “highly processed foods”, “fast food” and “take away” was associated with the rising prevalence of nutrition-related health problems in Iran. Participants believed that education programs should provide regular warnings about the disadvantages of these unhealthy foods.

Some participants were of the view that regular education (in conjunction with feeding children with healthy foods from early childhood in the home setting) was likely to influence later healthy food selection behaviors.

“In Iran, we have had lots of dramatic changes. These changes have been a sort of modernization. Dietary culture has changed. Lots of people mainly eat out of home” (15-GH)

3-1-2 Reading and understanding food labels

Several participants believed that improvements in food labels were required for various food products. They expressed a view that if people’s knowledge were improved, this would increase the demand for healthier products and for the development of more appropriate food labels for all foods. This would lead to positive influences over food manufacturers and other relevant organizations.

3-1-3 Economic constraints and food choices

The financial constraints on some Iranian families were considered to affect their healthy food choices in a negative way. Budget management tips were suggested to be incorporated into education programs. The identified budget tips included: equipping students with knowledge of accessible and affordable alternatives within each

food group to provide their nutritional requirements; encouraging students to buy seasonal foods (e.g. for fruits and vegetables); and informing students about equivalent nutritional values of some cheap foods versus similar expensive products (e.g. a cheap small apple is similar to a large expensive apple).

“We always say do not eat fast foods and eat healthy foods. However, some factors are important in this area like economic issues. For example, fast foods, take away foods and some pre-prepared foods are cheap, quick and accessible. Thus in our education and food-related planning, we need to consider these issues” (18-A)

“They need to know what are the best choices based on their economic power” (15- Gh)

3-2 Food preparation and cooking skills

Some participants (particularly teachers) highlighted the need for the acquisition of cooking skills, as students would soon become independent and need to cook for themselves and/or their family members.

Some experts referred to the positive culture of Iranians cooking foods at home. However, they also identified the need to modify some poor practices (e.g. frying vegetables for a long time, using too much oil and consuming too much rice). They believed that the provision of simple, practical tips for healthy cooking would be helpful, for example poaching, steaming and grilling methods versus deep-frying; cooking meat thoroughly for safety reasons, and limiting salt and oil use.

“It is necessary for school-leavers to have some skills of food preparation at home and also healthy methods of traditional cooking” (5-I)

“For example, we can mention that a proper simple method for cooking vegetables to keeps their nutrients is steaming. When you are steaming rice, put the vegetables on top of it” (14-S)

3-3 Knowledge of food storage and food safety principles

Participants from different specialties believed that to reduce the incidences of foodborne illnesses, it was necessary to improve school-leavers' knowledge of safe food practices during

the preparation, cooking, and storage of foods at home. They also noted relevant information specific to the food situation in Iran, including appropriate methods of consuming tinned foods (i.e. boiling tins for 20 min before opening); skills for shopping for safe, non-packed foods like meat and fish; and the need for caution regarding some food products because of overuse of pesticides and other harmful substances in the production of some agricultural products (e.g. phosphate in some vegetables) and animal products (e.g. nitrate in cows' milk). They considered such information would allow young people to make more informed food choices and enable them to put pressure on producers to meet the food production regulations.

“Iranian school-leavers might be involved in food preparation and storage at home and it is important to increase their knowledge of food safety issues to prevent food-borne illnesses” (4-H)

3-4 Minimization of food wastage

Everyday food practices also included knowledge and skills for minimizing food wastage at the household and production level. For minimizing food wastage in households some experts mentioned the importance of proper storage, planned shopping and selecting food products with environmental friendly packages.

4-Knowledge of prevalent nutrition problems in Iran

The dietitians, nutritionists, and public health nutritionists focused on education about common nutrition-related health problems in Iran such as overweight, obesity, diabetes, cardiovascular diseases and micronutrient deficiencies (e.g. iron, zinc, vitamin D and vitamin B). Two participants raised the need for informing students about eating disorders (e.g. anorexia and bulimia nervosa), particularly among teenagers and young adults. The participants assumed that awareness about the consequences of prevalent nutrition-related health problems, in conjunction with the provision of nutrition and physical activity recommendations, would be helpful for the prevention and management of such problems.

“At present, we are struggling with chronic diseases in Iran and nutrition-related awareness is really crucial” (11-SH)

5-Improving students' ethical attitudes in the food domain

A few participants mentioned ethical attitudes of students in the food domain, particularly in terms of animal welfare and environmental sustainability. These experts highlighted animal welfare issues in livestock production systems (e.g. methods of raising farm animals and the benefits of free-range methods). The participants also highlighted the need for providing insights into the value of reducing consumption of animal-based proteins to fulfill daily nutrition requirements, and the importance of respecting and preserving nature through better management techniques and water and soil use. The ethical importance of minimizing food-related wastage was also raised. “Those who respect nature, creatures, earth, soil and plants and try to preserve the world for the next generations have valuable attitudes” (11-SH).

Discussion

This study identified a broad range of nutrition and food systems issues that nutrition and food system experts in Iran considered were important for students to learn during schooling. The results collectively present a broad perspective of nutrition and food systems knowledge issues reflective of the NNS framework and its principles (23). The wide range of nutrition and food systems knowledge issues was not unexpected, as broad, open-ended questions were used in the interviews and the participants were experts from a range of fields relating to nutrition and food systems.

Few previous studies have considered broadly based nutrition and food system knowledge. One comprehensive investigation focused on food literacy and its components, however ethical dimensions within the food domain, such as environmental sustainability and animal welfare, were not considered (24). Of the food knowledge areas identified in this study, three have been consis-

tently reported previously and two less frequently discussed in food and nutrition knowledge literature.

Knowledge of nutrition basics, particularly with reference to national policy guidelines, has been identified in previous studies (25-27). This focus reflects many of the participants' attitudes toward the important roles of food-based dietary guidelines for Iranian population groups that take into consideration lifestyle changes, socio-economic situations and nutritional transition issues, which have led to increases in the prevalence of chronic diseases and micronutrient deficiencies (28).

The expressed need for ‘knowledge about everyday food-related practices’ is consistent with the findings in other studies. Previous literature has identified reading and understanding food labels (29), developing cooking skills (7), and knowledge of food safety issues (5) as important areas of knowledge. An additional issue raised in this study was the importance of knowledge about nutrition transition issues, including consumption of junk foods, fast foods, highly processed foods and take away foods, and the need for cautioning students about their potential harms. The existence of nutrition transition issues have been reported in the literature since 1970s (30) and reported in Iran (31) but it has not previously been highlighted as an important aspect of knowledge to include in school curricula.

The need for school students to have knowledge of prevalent nutrition-related health problems in Iran, in conjunction with nutrition-related recommendations for prevention and management of chronic diseases, were also reported in this study. This is consistent with previous work which refers to nutrition knowledge as an essential element of health literacy (32).

This study identified two areas of food knowledge, raised less frequently in the food and nutrition knowledge literature. One area was ‘knowledge of food production’ with a focus on environmental sustainability. While research on sustainable food systems has been reported (33- 34), only a few studies have explored the knowledge required of food production or of food systems more broadly. One previous study surveyed high

school students in the United States to assess their knowledge, attitudes, and experiences of the food system. A high level of detail of food systems content knowledge was explored in that study (9), as it was the main focus of the study. A lesser focus on food system knowledge in the current study may reflect Iranian experts' lower expectations of students' awareness of food systems, their preference for only teaching the basics of food production systems or that food system knowledge was being explored within a more broadly based discussion.

In the food production knowledge area, the need for developing skills in growing and harvesting crops was identified. This was mainly aimed at the improvement of students' skills relating to, and attitudes towards, farm-related jobs. This is different to previous studies, where food production knowledge issues were focused more on gardening education programs to improve dietary behaviors such as fruit and vegetable intakes (35). Enhancement of school leavers' ethical attitudes in the food domain, particularly in terms of environmental sustainability issues in relation to food production systems and animal welfare, has been reported least frequently in previous food knowledge literature. Consumers, policymakers and producers around the world had become more mindful of farm-animal welfare (36). Other literature discusses the influences of consumers' food choices or impacts of food production systems on climate change and the environment (37). The current study identified the importance of ethical food-related issues that enable school-leavers to make value-based food choices.

Study findings were analyzed using the multidimensional framework for knowledge and learning (20). The range of areas of knowledge identified by the participants reflected all three facets of knowledge including explicit (e.g. recommendations in policy guides), implicit (e.g. cooking skills and growing and harvesting crops) and emancipatory (animal welfare and environmental sustainability). However, the major foci of the participants' responses were on knowledge of practical issues, information for everyday use and developing practical skills. Thus by considering Yang's

epistemology of knowledge, overall the participants had greater focus on implicit knowledge (practice) and those specific parts of explicit knowledge (scientific principles) that could directly affect implicit knowledge. Only a few of the participants highlighted the critical role of value-based issues (emancipatory knowledge) in food education programs.

Utilization of Yang's knowledge framework in this study provides a broader understanding of nutrition and food-related topics in education programs. Adoption of such theoretical frameworks is not common in the food and nutrition knowledge domain. This may be one reason why the multidisciplinary nature of food and nutrition science has not strongly reflected in education programs to date.

Conclusion

Findings of current study provide a guide to curriculum developers and policy makers to assess current education curricula in order to optimize students' knowledge of nutrition and food systems.

Ethical considerations

Ethical issues (including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interests

The authors declare that there is no conflict of interest.

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Appendix 5: Chapter 8 published as a journal article



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Letter to the Editor

Gaps in Iranian School-leavers' Current Knowledge of Nutrition and Food Systems

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Dear Editor-in-Chief

There is a scarcity of literature exploring Iranian people's knowledge of a wide range of nutrition and food system (N&FS) issues. Twenty-six experienced Iranian food-related experts from different provinces of Iran (Fars, Tehran, Isfahan and Gilan) were interviewed between September 2012 and December 2012 to explore their views of gaps in Iranian school-leavers' current knowledge of N&FS. Thematic analysis approach was employed to analyze the qualitative data. Five key themes emerged from interview transcripts, briefly described here:

- 1) Generally poor, and scattered knowledge across most of the N&FS areas; even those related to fundamental nutrition issues such as appropriate nutrition for growth and development; malnutrition; food and chronic diseases; foodborne illnesses and other food safety issues reported by most of the participants. Previous Iranian literature has not directly assessed students' and school-leavers' knowledge of identified fundamental nutrition issues.
- 2) Substantial lack of specific knowledge of food systems; in relation to agriculture, food production, food processing and environmental issues associated with food systems. The major reason for this knowledge deficit was identified

as a lack of attention to food systems topics within schools' education curricula and general societal education (e.g. through mass media). There is absence of literature exploring Iranian populations' knowledge of food systems issues. However, the importance of food systems knowledge has been reported in international literature as "our food choices not only affect our health, but they can also have wide-ranging implications for the sustainability of food production and natural resources" (1)

- 3) Knowledge and attractiveness of N&FS topics to students; school-leavers have some knowledge about topics that are appealing to them, particularly those related to their physical appearance (e.g. weight issues), and physical activity and sports performance. However, experts expressed their concerns about the accuracy of students' and school-leavers' knowledge of these issues, due to the unreliability of their information sources, for example, gymnasiums. International literature also has raised concerns about poor quality of some information provided to young population groups. A Brazilian study of the nutrition knowledge and dietary recommendations by coaches to adolescent athletes found that coaches

recommended dietary practices such as very low-fat diets; over emphasize on proteins, and perpetuated food myths (2).

4) Determinants of current N&FS knowledge, that positively or negatively affected the current N&FS knowledge of Iranian school-leavers. These included the content of school textbooks; the attractiveness of food and nutrition topics for students; students' geographical location (urban or rural); the family environment (parent's occupation, for example farmer or office worker, and parents' own knowledge and practices of nutrition and food systems); mass media activities; and duration of food and nutrition education programs provided for students. Overall, the participants believed that at present Iranian schools and mass media do not use their potentials to deliver important nutrition and food systems information to Iranian population groups. The participants' identification of insufficient nutrition information in schoolbooks is consistent with a recent Iranian study that concluded the potential of primary school textbooks to deliver health-related messages (e.g. nutrition) has not been fully utilized (3). These findings differ from the common determinants of nutrition knowledge reported in existing worldwide literature, which includes educational level, age of students and family occupation (4, 5). Such differences may have arisen because most of the previous studies focused on nutrition knowledge alone, whereas in the present study knowledge of nutrition issues were explored in conjunction with knowledge of food systems. Additionally, previous studies did not explore experts' views on this matter. Experts are likely to take a wider perspective of influences on knowledge acquisition than the limited demographic indicators usually reported in quantitative surveys of knowledge.

5) Key barriers to students' study of N&FS at the school level, including food and nutrition information covered in school textbooks is inadequate and mostly not useful for everyday living; and some major areas of study taken by

students at high schools are limiting. Students studying in the science stream receive some food-related lessons; however, those studying in social sciences, mathematics and other majors are likely to be deprived of nutrition and food systems education.

The results of this study are important as they can inform the identification of neglected components of N&FS education within school curricula. More broadly, the findings can assist food and nutrition educators, curriculum developers and related policy makers to improve the current N&FS education programs in schools in Iran. Knowledge is power and better informed school-leavers are more likely to make healthy and sustaining food choices.

Conflict of Interests

The authors thank the participants of this study.

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Appendix 6: Chapter 9 published as a journal article

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Best Strategies to Improve School-leavers' Knowledge of Nutrition and Food Systems: Views from Experts in Iran

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ABSTRACT

Background: The research to date does not present an articulated approach to ensure nutrition and food systems education is systematically implemented within schools. This paper aimed to investigate food experts' views of the best strategies to improve school-leavers' knowledge of nutrition and food systems.

Methods: In this qualitative study, 28 Iranian food and nutrition experts from four major provinces (Tehran, Fars, Isfahan, and Gilan) were selected and agreed to be interviewed. Required data were collected through in-depth, semi-structured, face-to-face, or telephone interviews and were analyzed thematically using NVivo.

Results: The experts' suggested strategies to improve Iranian school-leavers' knowledge of nutrition and food systems fell into three key themes: Policy, education processes, and supportive environments. Together they formed an overarching theme of a multileveled system approach for transferring knowledge.

Conclusions: Development of a scaffolded education program could assist curriculum developers and policy makers to assess and update current nutrition and food systems education programs in schools. Insights gained about education initiatives in one country such as Iran can provide an important impetus to support nutrition and food system education more widely.

Keywords: Education strategies, food systems, Iran, knowledge, nutrition, school-leavers

INTRODUCTION

In the year 1970s, dietary behavior started to shift toward increased consumption of processed foods, fast foods, takeaway foods, sugary beverages, and fats. In the low- and middle-income countries, these changes started in the early 1990s, however, clearer when obesity,

diabetes, and hypertension became more widespread globally.^[1] Literature also reported that high consumption of energy-dense food choices, highly processed foods, and animal-based products, particularly beef and lamb, contribute to environmental degradation and climate change.^[2] Subsequently, the literature increasingly incorporates environmental considerations when discussing dietary and health issues,^[2,3] such as promoting environmentally sustainable diets, which are at the same time supportive of human health.

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The importance of nutrition and food knowledge and the need for relevant education have been widely reported and include dietary recommendations to adopt healthy dietary behavior,^[4] knowledge of food safety to prevent foodborne illnesses,^[5] cooking skills to promote healthy eating,^[6] and the need for knowledge related to reading and understanding food labels to allow more informed food choices.^[7] However, the research to date does not present an articulated approach to ensure nutrition, and food system education is systematically implemented within schools.

Studies have reported the important role of schools in disseminating nutrition information or food-related skills to a large proportion of the community.^[8,9] It is reported that "Nutrition education in schools offers a unique opportunity to integrate the teaching of nutrition and the application of that knowledge to achieve a behavior change."^[10] (p. 47) However, other studies have identified an underutilization of the potential to transfer important food and nutrition information in the school system.^[8,11,12]

Exploration of the best methods to be used by schools to transfer important nutrition-related issues has been reported.^[13,14] The World Health Organization (WHO), as a part of "Information Series on School Health,"^[13] reported that "the selection of an educational method should be based on the extent to which that method is appropriate to influence the factors, such as knowledge, attitudes, and skills associated with nutrition-related behaviors and conditions that contribute to health and to the prevention of malnutrition"^[13] (p. 19). This WHO document provides a range of examples of various educational techniques to improve knowledge, increase skills, develop positive attitudes and values, and minimize wrong beliefs. Other school-based nutrition education literature also reports on the need to consider a wide range of teaching strategies.^[14]

Complementing these broad approaches are papers that focus on single strategies to improve students' knowledge of nutrition-related issues at schools. For example, some researchers have suggested integrating nutrition information with other cases such as science during schooling,^[12,15] and others have recommended increasing nutrition messages within primary school textbooks.^[11] However, there is a lack of research addressing the broader structural barriers to the implementation of nutrition and food system education in schools. For example, do government education policies mandate or even articulate requirements for implementation of nutrition and food system education and how equipped are teachers to implement such education. Due to the universal gap in the scholarly literature on effective education frameworks and strategies to develop nutrition and food systems knowledge, this research explored experts' views on strategies to effect improvements in

education frameworks to develop nutrition and food systems knowledge. The targeted community in this investigation is Iranian school-leavers. However, to explore the generalizability of this guide, findings are compared with two international nutrition education guides and one holistic knowledge theory in relation to and learning. Included nutrition education guides are the WHO Information Series on School Health^[13] and "a logic model framework for community nutrition."^[16] Employed knowledge framework^[17] addresses the multifaceted nature of knowledge and defines different features of knowledge in the learning domain. This knowledge framework assists in the assessment of the extent to which the findings are inclusive and multidimensional.

METHODS

Participants

This study aimed to recruit 26 Iranian experts from various food-related fields, including four nutritionists, four dietitians, four public health nutritionists, four food scientists, two environmental scientists, two agriculture scientists, two veterinary physicians, and four high school teachers (health and home economics teachers), from major provinces in Iran were invited to participate in the study. Purposive sampling and snowballing methods were employed to recruit a group of acknowledged academics from top-ranked universities, experts with major roles in professional governmental and nongovernmental organizations and experienced experts from private institutes.

Participants were invited in person or by telephone. Appointments were made for each interview, and the participants were issued with the participant information sheet, interview questions, and consent form (all in Farsi) before the interview. Written and/or recorded verbal consents were obtained prior to the interview.

Data collection

Face-to-face or telephone semi-structured interviews with food-related experts were conducted in Iran between September and December 2012. Open-ended interview questions were used to explore experts' attitudes regarding the best strategies to improve Iranian school-leavers' knowledge of nutrition and food systems and to investigate their views on current knowledge of Iranian school-leavers of nutrition and food systems. Interview questions were developed by the study authors. The first author, for whom Farsi is her first language, conducted all interviews in Farsi and recorded them using two digital devices to ensure a backup recording in the case of equipment failure.^[18] Interviews were transcribed in Farsi and then translated into English by the first author. Interview questions used in this study are shown in Table 1.

Table 1: Open-ended questions used in interviews with Iranian food experts, translated from Farsi

What are the best strategies to increase the knowledge of school-leavers in relation to nutrition and food systems?
What do you think could be done differently to increase their knowledge?

Data analysis

To analyze the qualitative data, the thematic networks' approach^[19] was applied. First, each interview transcript was read, reviewed, and initial codes were noted. Then, the whole dataset was coded and reviewed to frame the basic themes ("lowest-order") from the text. Basic themes were then grouped into organizing themes or "middle-order" themes. Finally, organizing themes were grouped into a global theme to summarize the study outcomes in a meaningful way. This technique reflected thematic networks, a tool developed for qualitative analysis.^[19]

RESULTS

Sample characteristics

To achieve data saturation, the final number of 28 food-related experts were interviewed, including five nutritionists, five dietitians, five public health nutritionists, four food scientists, two environmental scientists, two veterinary physicians, two environmental scientists, one agriculture scientist, and four high school teachers (one health teacher, one home economics' teacher, one agriculture science teacher, and one food science teacher), from major provinces of Tehran, Fars, Isfahan, and Gilan.

Study participants were all experienced in food-related education programs and/or food-related policy making and/or very active in food-related research fields.

Thematic network reflecting strategies to improve Iranian school-leavers' knowledge of nutrition and food systems

The majority of participants when commencing their responses to the interview questions referred to the major problems within current educational programs in schools. They followed these points with their opinions on the best strategies to transfer the required knowledge to students. Identified problems in food and nutrition education programs at schools mainly related to the high volume of unnecessary theoretical information about nutrition science, the lack of practical and skill-based programs, the limited space in school textbooks for food and nutrition topics, the fact that food and nutrition education is only provided within particular majors at high school (e.g., for science stream) and not for all majors (e.g., not for mathematic stream), and the lack

of trained teachers who are qualified to teach food and nutrition topics at schools.

The experts' discussions on the best strategies to improve school-leavers' knowledge of nutrition and food systems generated a large number of basic themes. The basic themes incorporate a number of key phrases and terms from the transcripts of different participants all referring to the same issue and are termed key basic themes in this paper (e.g., in relation to the key basic theme of "training school teachers" there were several primary themes such as "teachers require food-related training programs," "we should transfer nutrition and food systems information to our teachers," and "teachers might not have adequate knowledge in these areas"). Key basic themes were grouped under three major organizing themes: Policy, process of education, and supportive environment. These organizing themes shaped the need for a multileveled systems approach, presented as the global theme in this paper. Figure 1 has summarized these findings.

Global theme: Multileveled systems approach

Experts raised a large number of issues as essential components of nutrition and food systems education program in schools. Their suggestions were collectively compiled into a multileveled framework consisting of three sections or three organizing themes, including policy, process of education, and supportive environment.

Organizing theme 1: Policy

Participants reported the need for some inter- and intra-disciplinary improvements in current policies directed to nutrition and food systems education programs in schools, from primary school to high school. Participants referred to the national government as the key creator and director of these policies and highlighted the need for macro-level negotiation with key policy makers who might be influential regarding the implementation of the required actions. Policies that were identified as necessary are shown as key basic themes.

Creating an "interdisciplinary team"

A critical step to improve school-leavers' knowledge of nutrition and food systems was identified to improve the collaboration between the Ministry of Education, Ministry of Health, food-related experts in various fields, and other food-related governmental and nongovernmental organizations. Experts reported the need for an "interdisciplinary team" of acknowledged experts, educators, and policy makers across various nutrition and food systems domains who might be influential in improving school-leavers' knowledge of important nutrition and food systems issues. This was important both in terms of the different disciplines knowing about the perspectives of the other areas and also to achieve an agreed, shared outcome.

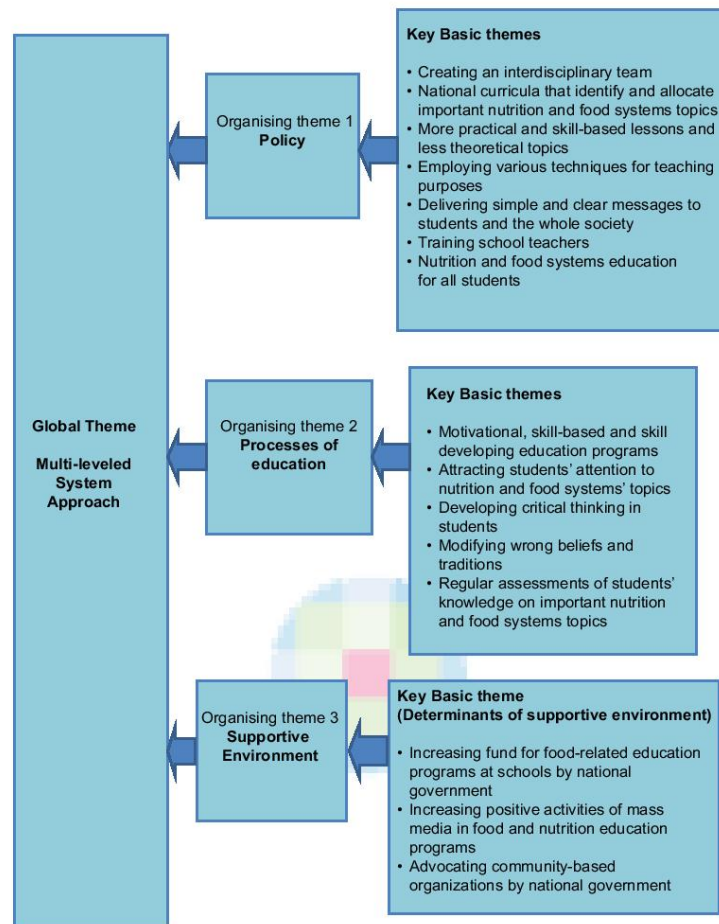


Figure 1: Thematic network reflecting strategies to improve Iranian school-leavers' knowledge of nutrition and food systems

“We need to make an interdisciplinary team..., we cannot handle the whole thing. ...Then we need to create a common language” (15-Gh).

“Universities and Ministry of Health are not integrated enough with education department (Ministry of Education)... This collaboration is necessary to improve food and nutrition information within school books” (20-V).

National curricula that identify and allocate important nutrition and food systems topics

Some participants talked about a stepped approach to developing national curricula. Experienced experts from different food-related disciplines first need to identify the important nutrition and food systems topics.

Then, because of the “fundamental role of schools in improving the knowledge of people within different societies” (20-V) (3-GH), the Ministry of Education should allocate enough “time” and “space” for these topics within schools' national curricula. Some experts expressed the view that this education needs to be started from the primary school and then continued until graduation from high school. In addition, highlighted was the need for information to be updated regularly by acknowledged experts within related nutrition and food systems disciplines. This issue was reported in conjunction with the need for regular assessments of students' nutrition and food systems knowledge to determine their common strengths and weakness for further decision-makings.

"It is needed that a group of experts determines what is needed for students from primary school till they get graduated from high school to know about nutrition and more broadly about food. Then, these topics should be fitted within schools' education curricula" (25-S).

More practical and skill-based lessons and less theoretical topics
The majority of participants highlighted the need for a significant decrease in "theoretical" and unnecessary information within school's educational programs, which were identified as very scientific nutrition information such as "structure of protein and carbohydrate". Participants raised the need for increased focus on topics which were "practical" and allied with people's "everyday life," for example, "food groups," "appropriate alternatives within each food group," and foods associated with people's health conditions. In addition, the need for offering more skill-based educational programs such as cooking and gardening courses during schooling was reported.

"In our schoolbooks, the major focus is on theoretical issues,...they are not used in people's routine life... students just memorize them to get some marks at their exams, just that" (1-A).

"Students don't learn enough skills at schools" (11-SH).

Integrating nutrition and food systems topics with other subjects
A few participants expressed a preference for a separate food-related subject to be taught in schools. However, most of the experts had the view that a separate subject was unlikely to receive approval from the Ministry of Education. These experts suggested that integrating nutrition and food systems topics within current relevant subjects may be more effective.

"The main focus should be on importing these issues into relevant subjects in a very clear and systematic way" (18-A).

Employing various techniques for teaching purposes

Almost all study participants referred to limited space within school textbooks to cover all important nutrition and food systems knowledge issues. To deal with the lack of space in textbooks, some experts recommended that in conjunction with textbooks, other techniques and tools were required, such as videos, clips, pictures, posters, and visiting tours. These educational instruments could be prepared and distributed by the Ministry of Education so as to provide consistent messages and information to a wide range of schools, while others could be developed by schools to reflect their students' unique needs.

"Kids are really interested in educational clips... [and] they really like visiting tours of: Various food factories, different stages related to food production, food processing, also growing and harvesting different crops" (23-R and Sh).

"Documentaries related to food in conjunction with environmental issues are a good idea" (17-D).

Deliver simple and clear messages to students and the whole society
The majority of experts reported that regardless of the sources of nutrition and food systems information provided (e.g., books, media, websites, and clips), all messages should be "simple," "clear," and "easy to understand." This issue was not limited to students. School teachers and other population groups were also considered to need simple and clear nutrition and food systems information that was useful for everyday life.

"We need to simplify the components of our education programs, particularly those that are related to people's routine life, such as nutrition and food systems issues" (8-M).

Training school teachers

Participants reported that school teachers are not equipped and updated with nutrition and food systems knowledge issues. Consequently, experts highlighted the need for pre- and in-service education programs for school teachers on important nutrition and food systems topics to enable them to offer accurate and updated information to students.

"Our teachers are not really trained in nutrition and food systems. How can they transfer the required information to their students... We need to arrange training workshops for teachers" (24-Gh).

Nutrition and food systems education for all students

Most of the participants reported that at present, students within mathematic, social sciences, and some other majors of study do not receive food and nutrition education at schools. They highlighted that nutrition and food systems education should be provided for all students regardless of their education majors.

In summary, participants reported the need for implementing several policies covering collaboration between related organizations, revision of schools education curricula, methods for transferring information, agreed simple concepts, and education for all students and food-related educators at schools.

Organizing theme 2: Process of education

Participants reported the need for running or expanding some interventions and activities at schools which were mainly related to the process of education.

Motivational, skill-based, and skill developing education programs

A large number of reported interventions for nutrition and food systems education programs at schools were suggested, with foci on the education being skill-based, skill developing, motivational, and recreational. These suggested interventions were gardening sessions, cooking classes, healthy food exhibitions, tours of farms and

factories, various food-related workshops for students and teachers, setting presentations for students and allocating rewards for best presentations (e.g., extra marks for final grade), small food projects for students, and regular speeches on nutrition and food systems issues by food-related experts for teachers, students, and their parents.

"Students can grow some vegetables in pots or boxes at school. Or if they have garden or yards at school, they can grow various crops" (8-M).

"Some tours to see different stages of food production. ... to a farm to see how wheat grows, then to a factory to see how the flour is produced, after that to a pasta factory. This can be done for dairy products, meat, etc." (4-H).

Attracting students' attention to nutrition and food systems topics

The other reported intervention was "attracting students' attention" to the important nutrition and food systems topics. The expert participants made a number of suggestions for attracting students' attention to nutrition and food systems topics that could be grouped in two main ways. One set of techniques for engaging students had a focus on teaching students their favorites topics and using these topics to fit in other relevant important issues (e.g., nutrition in conjunction with "fitness," "sport," "weight loss," "weight management," "beauty," and "intelligence"). The second set of techniques suggested using attractive methods of education, such as visual techniques, for example, CDs, clips, and tours.

"We should not only use books. There are more attractive methods like clips, animations, movies, or plays (e.g., videos about osteoporosis)" (20-V).

"Young boys are looking for foods that make them stronger and more muscular... girls are interested in food and beauty and weight management issues" (14-M).

Developing critical thinking in students

The other reported education intervention was developing critical thinking among students to assist them to broaden their views of various food-related issues. Participants raised the need for improving research skills in students and allocating more research-based assignments for students using "question and answer" techniques in education programs, moving beyond food and health topics, for example, discussing food and nutrition issues in relation to environmental issues, and further use of visual techniques for food education programs such as pictures and video clips.

"To retain students' attention to the lesson and to develop critical thinking among them, teachers can start the lessons with some questions. For example, I ask my student what should we eat? While I am modifying their answers, I discuss food groups with them. Then, I ask them how should those our meals? How should we

prepare our meal? And I will discuss diversity and balance in diet and after that method of cooking... it will make them think more actively" (5-J).

Modifying beliefs and traditions

Some participants raised concerns relating to the presence of misleading or incorrect information within society that have either been passed on through food-related traditions or through contemporary structures within society (e.g., "through gyms"). Several experts expressed that although traditions and culture can have important and constructive roles in some food-related practices (e.g., preparing and cooking foods at home, consumption of herbs and vegetables), there also are some traditions that are less aligned to evidence-based nutrition, such as "over consumption of white rice," "frying vegetables for a long period of time," and "preparing oily foods." Such practices could be modified through informing students or through education from earlier stages of life. In addition, experts reported that food educators need to be informed about reliable sources of food and nutrition information, such as appropriate websites and magazines so that they may inform students and regularly warn students about inappropriate sources of nutrition information.

"Some people may think that beliefs and traditions are always correct. They think these traditions are correct because they have been generated from 100 years ago, and their parents have used them as well. However, they might not be correct. Kids should know this issue and need to be able to distinguish between... traditions" (5-J).

"Some assume that to be fit they need to eliminate carbohydrates from their diet and should mainly consume proteins... Unfortunately, some gyms give these recommendations" (5-J).

In summary, experts identified interventions for nutrition and food systems education at the school level, which could ultimately improve students' knowledge before school-leaving age.

Organizing theme 3: Supportive environment

The need for a supportive environment to improve school-leavers' knowledge of nutrition and food systems was identified. Three determinants of a supportive environment were discussed.

The first determinant was sufficient funding for food-related education programs at schools. It was considered to be the responsibility of the national government to provide such funding, which should be directed to skill-based education programs and workshops for students and teachers in nutrition and food systems domains.

"Owing to lack of funds, we don't have enough skill-based courses at schools and all we have is theoretical training.

For example, kids do not have any knowledge about gardening” (23-R and Sh).

The second determinant of a supportive environment was the creation of positive activities around food and nutrition education programs in the mass media. Several experts stated that the mass media needs to provide continuous, diverse, and recreational educational programs in nutrition and food systems fields. The experts’ foci were mostly related to increasing advertisements of healthy foods and healthy eating behaviors, documentaries related to the production of foods from farm to fork, and competitions for students at radio and television to test their nutrition and food systems knowledge.

“We need to create a campaign to improve people’s knowledge. Radio and television could have a fundamental role in this campaign... We haven’t done planned and coherent campaigns through mass media up to now” (11-SH).

The third determinant for a supportive environment was support from the national government to engage community-based organizations which are active in food and nutrition education programs.

“Government needs to support institutes that are active in developing reliable journals, website, and weblogs... It is great to be in touch with students ...they show lots of interest... Government supports could positively affect these institutions” (11-SH).

In summary, the experts reported the need for further financial support of government for nutrition and food systems education programs; further incorporation of mass media in nutrition and food systems education programs; and governments’ support of institutes which are active in community’s food and nutrition education. These interventions together underscore the need to create a wider supportive environment for nutrition and food systems education programs mainly by the national government in Iran.

DISCUSSION

This investigation developed a guide of best strategies to improve school-leavers’ knowledge of nutrition and food systems. The study findings were compared to three international guides including the WHO Information Series on School Health, document four,^[13] a logic model for community education program,^[16] and a holistic approach on knowledge in conjunction with learning.^[17] The experts’ suggestions to improve school-leavers’ knowledge of nutrition and food systems were grouped into policy, process of education, and supportive environment. These components collectively provide a basic framework to support nutrition and food

systems education during schooling. Previous literature has reported separately on some of the components of such an education framework. To our knowledge, this is the first time a multilevel framework for strategies to improve school-leavers’ knowledge of nutrition and food systems has been developed.

The component “Policy” incorporates policies that were identified as required to improve nutrition and food systems education programs at schools related to creating a multidisciplinary team of key policy makers, acknowledged experts and educators across different nutrition and food systems domains, improvements in nutrition and food systems components of national education curricula and methods of delivering information, and other educational interventions for both students and teachers at the level of national. Earlier “policy-focused” studies have reported on food and nutrition policies at the level of schools, particularly those aimed at interventions to improve healthy eating behaviors among children.^[20-22] However, this investigation has highlighted policies that could improve the quality of education initiatives. Some of these policies components have been reported in the international literature, including the importance of skill-based education programs at schools such as gardening,^[23] and cooking,^[24] integrating nutrition topics with other subjects at schools,^[12] employing various techniques for teaching purposes,^[13,14] and education of school teachers.^[13] However, not all policies reported by participants in this study have been discussed previously.

“Process of education” in nutrition and food systems, the second organizing theme identified in this study reflected interventions that facilitate and improve the process of knowledge transference to students during schooling. A novel issue identified was the importance of attracting students’ attention to nutrition and food systems topics. There are some studies related to nutrition education at school which have previously highlighted the need for considering students’ interests in nutrition education programs.^[8,14] The other education concept identified by participants was related to the development of students’ critical thinking about nutrition and food systems issues. This is consistent with a study related to the management of science learning, which referred to critical thinking as a key element in children’s educational development at every stage of school.^[25]

The third organizing theme presented in this study related to supportive environments. There were three major determinants deemed important facilitators of the environment to improve nutrition and food systems education programs that reflect the system-wide perspectives of the participants. The three determinants were financial support by governments for nutrition and food systems education programs, mass media activities, and government support for food and nutrition education

institutions. Supportive environments for food and nutrition education programs at schools have been viewed differently in the literature. For example, a supportive environment largely reflects school level policies which lead to healthy dietary behaviors,^[26,27] such as accessibility, availability, and affordability of healthy foods at school environment.^[26] The higher level supportive environment as described in this study may reflect the interests and experiences of the expert participants, who were in nationally recognized positions, or the particular needs and circumstances of nutrition and food systems education programs in the study country, Iran.

The key role of national government departments identified in this study also may reflect the “centralized type” education system of Iran and the role of central government in education-related decision-makings.^[25] Similar studies in other countries should incorporate exploration of the role/s of government agencies in the establishment of or support for changes in education programs needed to facilitate incorporation of nutrition and food system topics.

Overall, there is a lack of such guides, presented in this study, in both developing and developed nations. This paper had a focus on Iran. However, the basic framework for nutrition and food system education arising from this study’s findings might be helpful more widely and may inform international guides designed for education and learning purposes.

The present findings are consistent with the WHO document on school health, (document four),^[13] particularly with regard to some of the interventions identified under “policy” and “process of education.” Similarities were related to the importance of providing “practical” information for students rather than “scientific” details, training school teachers, and incorporating various methods for an effective education program. However, a major difference between the present study and the WHO report is that the WHO report focuses on health-related aspects of nutrition education at schools, while this study provides a broader view incorporating food-related education programs.

Similarly, the basic framework developed through this study has several similarities with the logic model framework for community nutrition by Medeiros *et al.*^[16] The logic model consists of the three major components inputs or resources (funding, human resources, equipment, and curricula), outputs (educational programs and participants reached) and outcomes. In the basic framework developed in this study, various issues reported under the organizing themes of “supportive environment,” “process of education,” and “policy,” align with “input” and “output” sections of the logic model. The qualitative nature of this study did not permit quantification of specific outcomes. However,

the participants did identify desired knowledge in the nutrition and food systems domains. Achievement of this desired knowledge could be tracked in future studies to determine their importance in impacting behavioral and health outcomes.

The study findings also were reviewed using the holistic approach of Yang’s epistemology of knowledge.^[17] Based on this approach, three facets of knowledge are considered such as explicit or scientific aspects of knowledge, implicit or knowledge in practice, and emancipatory or value-based features of knowledge. In this study, the participants identified the need for less theoretical food-related topics, an increase in practical and skill-based lessons, and the importance of motivational, skill-based, and skill developing education programs. These suggestions align with the need for further focus on implicit knowledge and decrease in explicit information. Examples of value-based themes (emancipatory knowledge) were incorporated in all three components of the basic framework, including nutrition and food systems education for all students, developing critical thinking in students, reflecting on beliefs and traditions, and support for community-based organizations that are active in food and nutrition education programs. In brief, the findings indicate the need for improvement and balance of the three facets of knowledge across nutrition and food system curricula.

CONCLUSIONS

This study developed a guide for strategies to improve Iranian school-leavers’ knowledge of nutrition and food systems, comprising three key elements of policy, processes of education, and supportive environment to be incorporated into current education programs. Findings of this study might inform international guides designed for education and learning purposes.

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Conflicts of interest

There are no conflicts of interest.

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