



Best Strategies to Improve School-leavers' Knowledge of Nutrition and Food Systems: Views from Experts in Iran

Sanaz Sadegholvad, Heather Yeatman, Nasrin Omidvar¹, Anne-Maree Parrish, Anthony Worsley²

School of Health and Society, Faculty of Social Sciences, University of Wollongong, NSW, Australia, ¹Department of Community Nutrition, Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran, ²Centre for Physical Activity Research, School of Exercise and Nutrition Sciences, Deakin University, Melbourne, Victoria, Australia

Correspondence to:

Ms. Sanaz Sadegholvad, 18 Ootana Street, Chapel Hill, QLD 4069, Australia. E-mail: ss709@uowmail.edu.au

How to cite this article: Sadegholvad S, Yeatman H, Omidvar N, Parrish AM, Worsley A. Best strategies to improve school-leavers' knowledge of nutrition and food systems: Views from experts in Iran. *Int J Prev Med* 2016;7:119.

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.

Access this article online	
Quick Response Code: 	Website: www.ijpvmjournal.net/www.ijpm.ir
	DOI: 10.4103/2008-7802.193094

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

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.

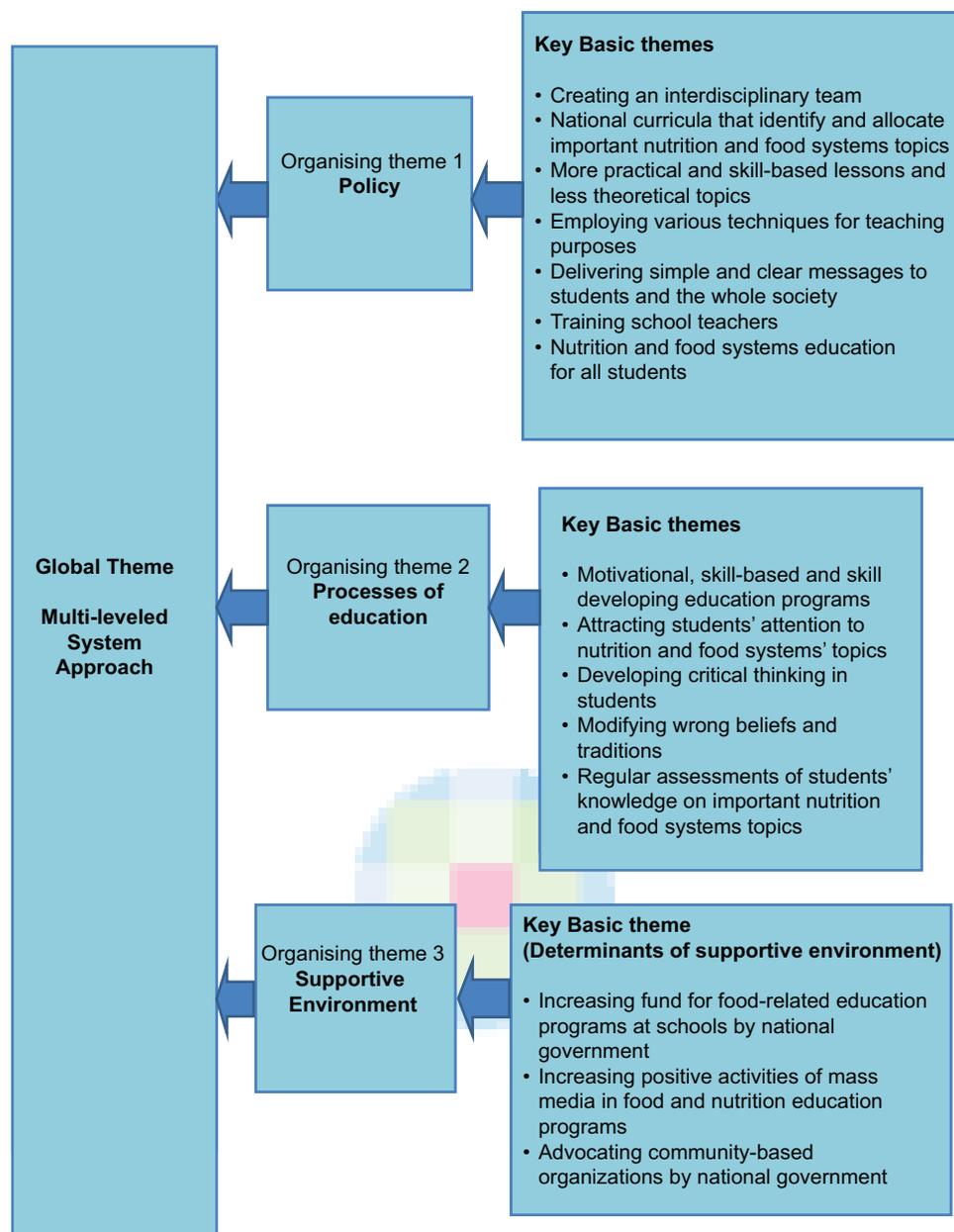


Figure 1: Thematic network reflecting strategies to improve Iranian school-leavers' knowledge of nutrition and food systems

“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.^[28] 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.

Acknowledgements

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

Financial support and sponsorship

This research was primarily supported by the first investigator of this study and partially supported through Higher Degree Research grant from University of Wollongong.

Conflicts of interest

There are no conflicts of interest.

Received: 21 Jun 16 **Accepted:** 07 Sep 16

Published: 26 Oct 16

REFERENCES

1. Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. *Nutr Rev* 2012;70:3-21.
2. Friel S, Barosh LJ, Lawrence M. Towards healthy and sustainable food

- consumption: An Australian case study. *Public Health Nutr* 2014;17:1156-66.
3. Public Health Association of Australia P. Policy-at-a-glance – Ecologically Sustainable Diets. PHAA is a national organisation in Australia; 2015.
 4. Milosavljevic D, Mandic ML, Banjari I. Nutritional knowledge and dietary habits survey in high school population. *Coll Antropol* 2015;39:101-7.
 5. Green EJ, Knechtges PL. Food safety knowledge and practices of young adults. *J Environ Health* 2015;77:18-24.
 6. Reicks M, Trofholz AC, Stang JS, Laska MN. Impact of cooking and home food preparation interventions among adults: Outcomes and implications for future programs. *J Nutr Educ Behav* 2014;46:259-76.
 7. Chopera P, Chagwena DT, Mushonga NG. Food label reading and understanding in parts of rural and urban Zimbabwe. *Afr Health Sci* 2014;14:576-84.
 8. Pérez-Rodrigo C, Aranceta J. Nutrition education in schools: Experiences and challenges. *Eur J Clin Nutr* 2003;57 Suppl 1:S82-5.
 9. Macnab AJ, Gagnon PF, Beery M, Adatia R, Segantin O, Skaer CF. School food gardens: Fertile ground for education. *Health Educ* 2014;114:281-92.
 10. Tab F. Nutrition education in schools. *Top Clin Nutr* 1999;15:47.
 11. Kazemian R, Ghasemi H, Movahhed T, Kazemian A. Health education in primary school textbooks in Iran in school year 2010-2011. *J Dent (Tehran)* 2014;11:536-44.
 12. Carraway-Stage V, Hovland J, Showers C, Díaz S, Duffrin MW. Food-based science curriculum yields gains in nutrition knowledge. *J Sch Health* 2015;85:231-40.
 13. World Health Organization. WHO Information Series on School Health document four. Healthy nutrition: An essential element of a health-promoting school. Geneva:WHO, FAO; 1998.
 14. Pérez-Rodrigo C, Aranceta J. School-based nutrition education: Lessons learned and new perspectives. *Public Health Nutr* 2001;4:131-9.
 15. Hovland JA, Carraway-Stage VG, Cela A, Collins C, Díaz SR, Collins A, et al. Food-based science curriculum increases 4th Graders multidisciplinary science knowledge. *J Food Sci* 2013;12:81-86.
 16. Medeiros LC, Butkus SN, Chipman H, Cox RH, Jones L, Little D. A logic model framework for community nutrition education. *J Nutr Educ Behav* 2005;37:197-202.
 17. Yang B. Toward a Holistic Theory of Knowledge and Adult Learning. *Hum Resour Dev Rev* 2003;2:106-29.
 18. Marwaha K, Horabin H, McLean S. Indian physiotherapists' perceptions of factors that influence the adherence of Indian patients to physiotherapy treatment recommendations. *Int J Physiother Rehabil* 2010;1:9-18.
 19. Attride-Stirling J. Thematic networks: An analytic tool for qualitative research. *Qual Res* 2001;1:385-405.
 20. Agron P, Berends V, Ellis K, Gonzalez M. School wellness policies: Perceptions, barriers, and needs among school leaders and wellness advocates*. *J Sch Health* 2010;80:527-35.
 21. Acham H, Kikafunda JK, Malde MK, Oldewage-Theron WH, Egal AA. Breakfast, midday meals and academic achievement in rural primary schools in Uganda: Implications for education and school health policy. *Food Nutr Res* 2012;56:1-12.
 22. Belansky ES, Cutforth N, Chavez R, Crane LA, Waters E, Marshall JA. Adapted intervention mapping: A strategic planning process for increasing physical activity and healthy eating opportunities in schools via environment and policy change. *J Sch Health* 2013;83:194-205.
 23. Christian MS, Evans CE, Nykjaer C, Hancock N, Cade JE. Evaluation of the impact of a school gardening intervention on children's fruit and vegetable intake: A randomised controlled trial. *Int J Behav Nutr Phys Act* 2014;11:99.
 24. Fisher C, Nicholas P, Marshall W. Cooking in schools: Rewarding teachers for inspiring adolescents to make healthy choices. *Nutr Bull* 2011;36:120-3.
 25. Chaipichit D, Jantharajit N, Chookhampaeng S. Development of learning management model based on constructivist theory and reasoning strategies for enhancing the critical thinking of secondary students. *Educ Res Rev* 2015;10:2324-30.
 26. Rowe F, Stewart D, Somerset S. Nutrition education: Towards a whole-school approach. *Health Educ* 2010;110:197-208.
 27. Hayati Adilin M, Holdsworth M, McCullough F, Swift J, Norimah A. Whole school mapping to investigate the school environment's potential to promote a healthy diet and physical activity in Malaysia. *Malays J Nutr* 2015;21:1-14.
 28. Behbahani A. Technical and vocational education and the structure of education system in Iran. *Procedia Soc Behav Sci* 2010;5:1071-5.

