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SPECIAL SECTION ON MOVING ON IPCC 1.5°C: SYSTEMATIC REVIEW

Integrating sustainable nutrition into health-related institutions: a systematic review of the literature

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Abstract

Objectives Sustainable nutrition is increasingly important, as the food system contributes one third of greenhouse gas emissions. Sustainable nutrition, or sustainable diet, refers to diets with low environmental impacts that contribute to food security and health. This systematic review aimed to identify factors that influence whether professionals in health-related institutions integrate sustainable nutrition into their practice.

Methods A mixed-methods systematic review was conducted using the MEDLINE, Embase, PsycINFO, and CINAHL databases. To be included, the studies had to document perspectives on sustainable nutrition from health professionals, including dietitians, students and educators in health sciences, public health officers, and hospital food service managers. Data extraction focused on perceived barriers, facilitating factors, and top recommendations for promoting sustainable nutrition.

Synthesis Twenty studies were included, most of which focused on dietitians. Data analysis revealed that 25 factors influenced the integration of sustainable nutrition into professional practice. The factors most reported in the included studies were perceived knowledge of sustainable nutrition, self-efficacy, awareness of environmental issues, and perceiving the promotion of sustainable nutrition to be part of one's professional role. Increasing societal support through awareness campaigns and increasing institutional support through guidelines, information tools, and financial support were also frequently mentioned.

Conclusion Sustainable nutrition is a multifaceted concept; integrating it into already complex professional practices is therefore challenging. At the present time, dietitians seem to be the health professionals predominantly researched regarding their views on sustainable nutrition. Many concrete avenues to promote sustainable nutrition were identified through this review.

Résumé

Objectifs Promouvoir l'alimentation durable est une priorité car elle contribue à un tiers des émissions de gaz à effet de serre. L'alimentation durable désigne des régimes alimentaires à faible impact environnemental qui contribuent à la sécurité alimentaire et nutritionnelle et à un mode de vie sain. Cette revue systématique visait l'identification des facteurs influençant l'intégration de l'alimentation durable dans la pratique des professionnels travaillant dans des institutions relevant de la santé.

Méthodes Une revue systématique mixte a été conduite avec les bases de données MEDLINE, Embase, PsycINFO et Cinahl. Les études devaient documenter les perspectives des professionnels de la santé, agents de santé publique ou gestionnaires des services alimentaires sur l'alimentation durable. L'extraction des données s'est concentrée sur les obstacles perçus, les facteurs facilitants et les recommandations pour promouvoir l'alimentation durable.

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Synthèse Vingt études ont été incluses. Leur analyse a permis d'identifier 25 facteurs d'influence. Les plus cités étaient les connaissances, le sentiment d'auto-efficacité, la prise de conscience des défis environnementaux et percevoir qu'intervenir sur ces défis fait partie de son rôle professionnel. Les autres facteurs fréquemment mentionnés étaient le soutien de la population grâce à campagnes de communication et le soutien institutionnel par l'accès à des lignes directrices, des outils d'information et du soutien financier.

Conclusion L'alimentation durable est un concept à multiples facettes; l'intégrer dans des pratiques professionnelles déjà complexes est un défi. Les diététistes semblent être les professionnels de la santé les plus interrogées sur l'alimentation durable. Plusieurs pistes d'action concrètes ont été dégagées.

Keywords Sustainable nutrition · Public health · Dietitians · Food supply managers · Health care facilities · Systematic review · Climate change · Greenhouse gas emissions

Mots-clés Santé publique · diététistes · gestionnaires de l'offre alimentation · établissements de santé · revue systématique · changements climatiques · gaz à effets de serre

Introduction

In recent years, increasing attention has been given to sustainable nutrition worldwide, following the Intergovernmental Panel on Climate Change reports on global warming (IPCC 2018) and the EAT-Lancet Commission on Food, Planet, Health recommendations for sustainable diets (EAT 2019a). Along the same lines, the Lancet Commission on Obesity coined the expression "the Global Syndemic" to demonstrate that the pandemics of climate change, under-nutrition, and obesity co-occur in time and place, interacting negatively with each other and sharing common systemic drivers, including an unsustainable global food system (Swinburn et al. 2019). Professionals working in health-related institutions are in a position to influence nutrition policies and implement interventions and are therefore particularly concerned with sustainable nutrition.

Worldwide, over 2 billion people suffer from micronutrient deficiencies (Bailey et al. 2015), and approximately 860 million people suffer from hunger (McGuire 2013). As well, nearly 2 billion people in the world are overweight or obese (WHO 2016b). These issues are aggravated by the fact that the world's population is expected to grow by 2.2 billion by 2050 (UNDESA 2015). In Canada, ultra-processed foods account for half of total energy intake (Nardocci et al. 2019); most of the population consumes an inadequate amount of fruits and vegetables (Statistics Canada 2019) and one in eight households experience food insecurity. A disproportionate increase in chronic illnesses among vulnerable populations is also associated with socio-economic inequalities (Tarasuk et al. 2015). The global food system has a major influence on these health variables by determining which foods are available in the food environments people encounter in their everyday lives and at what prices they are sold, and contributes to shaping people's preferences, norms, and food cultures more broadly (WHO 2016a).

The impacts of the food system on our planet are another serious concern. The food system is estimated to contribute up to 30% of global greenhouse gas emissions (GHGEs) (Vermeulen et al. 2012), and the United Nations Food and Agriculture Organization (FAO) estimates that the GHGEs associated with meat and dairy production alone account for 14.5% of all GHGEs globally (Gerber et al. 2013). Even the animal products with the lowest GHGEs impact consistently exceed the impact of plant products, even when these animal products are purchased locally or produced with little processing (Poore and Nemecek 2018). Agriculture is also responsible for 70–80% of all human water use (Jägerskog and Jønch 2012) and 38% of land degradation (Foley et al. 2011). As well, climate change is expected to have deleterious impacts on food production: models predict that up to 25% of world food production will be lost over the twenty-first century as a result of climate change (Springmann et al. 2016). While similar data are available for the transportation sector (19.2% of GHGEs), industry (30%), and energy production (47%) (Abraham et al. 2012), these industries are covered by policy programs and have been of great concern to many policymakers and governments. Yet, climate change mitigation policies have not yet been developed and widely implemented for the global food system. The alarming pace of biodiversity loss and ecosystem degradation (IPCC 2019), along with their negative impacts on health, provides a compelling case for re-examining our food systems and diets from a sustainability and public health perspective (Mason and Lang 2017).

The concept of sustainable nutrition was first introduced by Gussow and Clancy (1986), who argued that sustainability is vitally important to a healthy diet (Johnston et al. 2014). The concept failed to gain traction initially, and public attention remained more narrowly focused on "healthy" diets. In recent years, sustainable nutrition has experienced a renewed interest (Biesalski et al. 2017). In 2010, the FAO developed a consensus definition for "sustainable diets" as "diets with low environmental impacts that contribute to food and nutrition security and to healthy lives for present and future generations." They added to this definition five equally important guiding principles—

environment, health, equity, culture, and economy—and mentioned that sustainable diets "are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable, are nutritionally adequate, safe, and healthy, and optimize natural and human resources" (Burlingame and Dernini 2010, p. 7). These five principles are included in both sustainable nutrition and sustainable diets (used interchangeably in the present study).

In January 2019, the EAT-Lancet Commission introduced the Planetary Health Plate to set universal scientific targets for healthy diets and environmental sustainability (EAT 2019a). At the same time, Health Canada launched its new food guide, also illustrated with a plate (Health Canada 2019). Both plates consist of approximately half vegetables and fruits; the other half consists primarily of whole grains and plant-based protein, with optional modest amounts of animal protein and unsaturated plant oils. So far, only a few countries have started to incorporate sustainability objectives into their food-based dietary guidelines (e.g., Germany, Sweden, Brazil, Qatar). Such incorporation is of primary importance since dietary guidelines are the foundation of actions taken by professionals working in health-related institutions and more broadly in public services. As well, they nudge consumers toward sustainable eating and can increase demand for sustainable foods (Wegener 2018).

Various efforts have also focused on evidence-based food system action goals that could significantly reduce global warming, improve global nutritional health, and maintain food resources for future generations (Harmon et al. 2011). Our own review of recent dietary recommendations that take sustainability into account led to the identification of the following nine recommendations (Rose et al. 2019; Harmon et al. 2011; EAT 2019a; FAO and Food Climate Research Network 2016): (1) Increase consumption of plant-based protein relative to animal protein, and increase consumption of fruits and vegetables from various sources; (2) reduce consumption of animal-based protein, avoid processed meats in particular, and opt for poultry and eggs rather than grazing or fodder animals; (3) purchase fish from sustainable fisheries only; (4) choose fresh, whole, or less-processed foods; (5) choose unpackaged or less packaged foods, or foods with recyclable packaging; (6) choose seasonally available, local foods; (7) eat in moderation and avoid waste by using your leftovers and composting food waste; (8) choose pesticide-free, organic, and fair trade food; (9) learn about food production.

Although these recommendations make it easy to present the core aspects of sustainable nutrition, they carry a risk of oversimplification and should always be interpreted through the guiding principles of sustainable nutrition presented above (Burlingame and Dernini 2010). More concretely, it is important to pay attention to equity (e.g., promoting socio-structural changes in a context where eating sustainably is almost only possible for the privileged) and culture (e.g., for residents in northern Canada, especially in the context of reconciliation with Indigenous people, meat hunted locally is more sustainable compared with vegetables flown into communities).

In this context, public health officers (Gould and Rudolph 2015) and health professionals (Burlingame and Dernini 2010), including dietitians (Sulda et al. 2010) and hospital food service managers (Carino et al. 2020), have been highlighted for their potential role in promoting sustainable nutrition in health-related institutions. Concretely, public health officers could integrate sustainable nutrition principles into nutrition action plans or communication campaigns; health professionals could also do so in their clinical encounters with patients; and hospital food service managers through food supply and menu planning (e.g., EAT 2019b). All these professionals could also engage in advocacy initiatives to influence policies and in educational projects involving both professionals and the public. However, the extent to which these professionals are motivated and equipped to integrate sustainable nutrition into their practice remains unclear. Some studies have explored these professionals' views and experiences with sustainable nutrition in health-related organizations and provide information on what factors help or hinder the integration of sustainable nutrition into practice and which actions should be targeted. A synthesis of this information could provide guidance useful in developing interventions and policies for sustainable nutrition integration and, ultimately, climate change mitigation.

The objective of this study was to systematically review what factors influence whether health professionals, public health officers, and hospital food service managers integrate sustainable nutrition into their professional practice. More specifically, this review addresses the following research questions: What are the main characteristics of studies exploring the views on sustainable nutrition held by professionals working in health-related organizations? What do these professionals perceive to be the barriers and facilitators to integrating sustainable nutrition into their professional practice? What are these studies' recommendations for advancing the integration of sustainable nutrition in health-related organizations?

Methods

Design

Inspired by Thomas and Harden's framework (Thomas and Harden 2008; Harden and Thomas 2010), this mixed-methods systematic review aimed to synthesize qualitative and quantitative evidence from studies that have investigated the views of health professionals, public health practitioners, and hospital food service managers on sustainable nutrition. A version of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) adapted for reporting systematic reviews of qualitative and quantitative evidence has been

followed (Hong et al. 2018b). However, this research protocol has not been registered and is currently not available.

Search strategy

MEDLINE, Embase, PsycINFO, and CINAHL were searched in May 2019. No time restriction was set on publication date. The search was restricted to English- and French-language papers for practical reasons. A member of the research team (initials removed for reviewing process) and a librarian conducted the initial search. A combination of Medical Subject Headings (MeSH) terms, keywords, synonyms, and closely related words were used. The main key words were (healthcare professional or public health or food manager) AND (perception or opinion or attitude) and (sustainable nutrition). An example is provided in Supplementary Table 1 for MEDLINE. To identify additional studies, the references sections of the included studies and review articles were carefully checked manually.

Inclusion criteria

The following four inclusion criteria were used. First, participants were health professionals, students training to become health professionals, educators in health sciences, public health officers, or hospital food service managers (e.g., food service directors, kitchen managers, procurement officers). If other types of participants were included, the study had to report specific data for the aforementioned groups. This review excluded studies conducted only with food producers, manufacturers, retailers and marketing departments, and those with only patients and the general public. Second, the studies were qualitative, quantitative, or mixed-methods, and explored participants' views and experiences. Interventional designs (randomized controlled trials, non-randomized controlled trials), studies of public policies, systematic reviews, and position statement studies were excluded. Third, the studies explored participants' views on sustainable nutrition (defined as a field of study and practice on the processes used to feed oneself sustainably), the characteristics of sustainable diets (such as plant-based or vegetarian diets) or sustainable agriculture (defined as food production systems designed in particular for reducing the environmental impact of agriculture). Studies focusing on related environmental issues such as biodiversity loss, soil pollution, water waste, recycling, hospital waste management, and other topics were excluded. Fourth, the studies were published in English or French. All studies that did not meet these four criteria were excluded from the review.

Study selection

After eliminating duplicates, an initial screening based on title and abstract was conducted on 5796 records by two independent reviewers (initials removed for reviewing process, trained in family medicine and epidemiology, and initials removed for reviewing process, trained in management) using Covidence software (2018). Potentially relevant articles ($n = 139$) were then assessed for eligibility based on full-text analysis. For the abstract and title screening phase and the full-text screening phase, interrater reliability was measured using Cohen's kappa coefficients and was found to be very satisfactory for both (respectively, 0.94 [1.02–0.86] and 0.82 [0.96–0.70]). Discrepancies in abstract and title screening and the full-text screening were resolved through discussion.

Data extraction

Two reviewers (initials removed for reviewing process) extracted data using a standardized data extraction form that was tested and amended prior to the full review. Differences in data extraction were discussed during the pilot phase, and the definitions of each item in the extraction form were clarified to ensure reliability in the coding process. Data extraction covered three topics based on our research questions: background information, perceived barriers and facilitators, and the priority targets according to the study's authors. Background information included authors, year of publication, country, objectives, design, data collection and analysis methods, and sample characteristics. Perceived barriers and facilitators were systematically extracted from the results sections and authors' recommended priority targets to effect change were taken from the discussion sections. Complete sentences used in the papers were coded without reformulating. Any discrepancies in data extraction were iteratively discussed until consensus was reached.

Data synthesis

A three-step process was followed. First, the characteristics of included studies were described (e.g., year of publication, study country). Extracted data were categorized and quantified using means and frequencies. Second, a thematic analysis was conducted on the barriers and facilitators reported in results sections and on authors' recommendations in discussion sections. This data synthesis approach was considered most appropriate for answering this study's research questions since there was great heterogeneity in the design, objectives, samples, and outcome measures in the quantitative studies, precluding a meta-analysis. A hybrid deductive-inductive analytical approach was employed for coding. Initial codes and categories were derived from a previous taxonomy of barriers and facilitators influencing the practices of health professionals' practice (Légaré et al. 2008; Cabana et al. 1999) and the Theoretical Domains Framework (Cane et al. 2012). This framework synthesized cross-disciplinary implementation and behaviour change research, leading to the identification of 14 main theoretical variables influencing behaviour adoption

(including, among others, knowledge, beliefs about consequences, beliefs about capabilities, skills, professional identity, reinforcement, environmental resources). To ensure intercoder consistency, two reviewers (initials removed for reviewing process) independently extracted data from eight studies until a consensus on the initial codebook was reached. After that, reviewers independently coded the information per paper and debriefed after every four papers. In accordance with Thomas and Harden's framework (Thomas and Harden 2008; Harden and Thomas 2010), this comparison between team members' coding was conducted without quantifying the degree of consensus. Discussions with the research team were ongoing throughout the extraction data process, and new codes were added as necessary if reviewers were in agreement on these codes. Third, after data from each code was summarized, the main themes were identified. Factors that had an influence on the integration of sustainable nutrition were classified into four main categories: (1) professionals' social and demographic characteristics; (2) professionals' knowledge, attitudes, and values; (3) skills and professional practices; and (4) practice settings and health system characteristics. Each category included between three and eleven influencing factors.

Quality assessment

The methodological quality of all studies was independently critically appraised by two reviewers (initials removed for reviewing process) using guidelines from the Mixed Methods Appraisal Tool (MMAT) (Hong et al. 2018a). The MMAT was developed to allow systematic reviewers to assess the methodological quality of multiple study designs; it has been validated and its quality and accuracy were recently updated (Souto et al. 2015). Discrepancies were discussed until an agreement was reached for each study. Any further disagreement was resolved through discussion with a third author (initials removed for reviewing process).

Synthesis

Sixteen studies met the inclusion criteria, and four more studies were added after reviewing the references (see the flowchart in Fig. 1 for more details). In total, 20 studies were included in the current review ((1) Carlsson et al. 2019; (2) Carlsson et al. 2017; (3) Casagrande et al. 2011; (4) Dauner et al. 2011; (5) Duncan and Bergman 1999; (6) Edelstein et al.

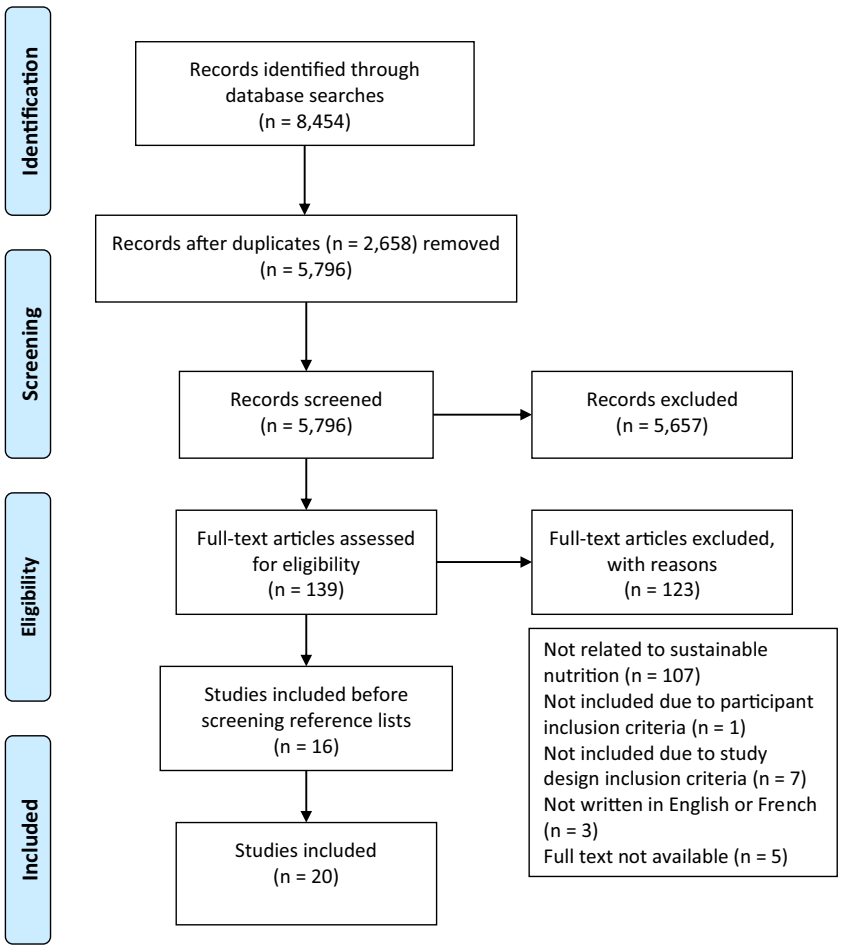

Fig. 1 Flowchart

2010; (7) Harmon et al. 2011; (8) Hawkins et al. 2015a; (9) Hawkins et al. 2015b; (10) Hawkins et al. 2015c; (11) Hawkins et al. 2015d; (12) Heidelberger et al. 2017; (13) Hughes et al. 2014; (14) Nuttman et al. 2020; (15) Robinson and Smith 2003; (16) Spencer et al. 2007; (17) Sulda et al. 2010; (18) Webber and Sarjahani 2011; (19) Wilson and Garcia 2011; (20) Worsley et al. 2014). No study was excluded based on the quality threshold, in accordance with the MMAT (Supplementary Table 2). All studies were published in English between 1999 and 2019. Most studies (14, or 70%) were conducted in the United States, three were conducted in Canada, and three in Australia. Sample size at baseline ranged from 16 to 1849. This large range was mainly due to different research designs. Twelve studies (60%) were quantitative, six were qualitative, and two were mixed methods. Seventy percent (14 out of 20) were conducted among dietitians. Other participants were hospital food service managers, teachers and directors of dietitian education programs, public health officers, and medical students. Tables 1 and 2 summarize the information on the included studies.

Factors influencing the integration of sustainable nutrition into professional practices

Data integration led to the identification of 25 factors that had an influence on the integration of sustainable nutrition (see Table 3). Since each factor could be presented in the included studies as either a barrier or a facilitating factor, and since various research designs were used to identify these factors (e.g., qualitative studies as well as quantitative correlational and longitudinal studies), they are presented in the text as

Table 1 Descriptive characteristics of studies included in the review

Characteristics	Number of studies (reference number)*	Percentage
Year published		
1990–1999	1 (5)	5%
2000–2009	3 (15–17)	15%
2010–2019	17 (1–4, 6–14, 18–20)	80%
Sample size		
17–24	3 (9–11)	15%
25–49	2 (1, 4)	10%
50–99	4 (2, 14, 18, 19)	20%
100–199	6 (5–7, 13, 15, 17)	30%
200–1849	5 (3, 8, 12, 16, 20)	25%
Country		
USA	14 (3–13, 15, 16, 18)	70%
Canada	3 (1, 2, 19)	15%
Australia	3 (14, 17, 20)	15%
Design		
Qualitative	6 (1, 2, 4, 9–11)	30%
Quantitative, cross-sectional	11 (3, 5–8, 12, 13, 15, 18–20)	55%
Quantitative, longitudinal	1 (16)	5%
Mixed methods	2 (14, 17)	10%
Participants		
Dietitians, nutritionists	14 (1, 2, 5–13, 15, 17, 20)	70%
Food service managers	2 (4, 19)	10%
Public health officers	1 (14)	5%
Researchers and experts	1 (1)	5%
Dietetic program directors	1 (18)	5%
Medical students	1 (16)	5%
Participants' practice settings		
Food services	2 (4, 19)	10%
Research and teaching	2 (16, 18)	10%
Public health	1 (14)	5%
Multiple settings included in sample	15 (1–3, 5–13, 15, 17, 20)	75%

*The reference associated with each identifying number is reported in the synthesis section (first paragraph)

Table 2 Summary of the main characteristics of the included studies

Authors (year) country	Main objective of the study	Study characteristics (1) Study design (2) Approach (3) Data collection tool	Participant characteristics (1) Type of participants (2) *N* (sample size)
Carlsson et al. (2017) Canada	To develop a tool for tracking progress toward sustainable food systems and supporting community determinacy	(1) Qualitative (2) Grounded theory (3) Delphi Enquiry Process	(1) Public health officers (2) *N* = 31
Carlsson et al. (2019) Canada	To set out language defining sustainable food systems and identify leverage points where dietitians can affect change	(1) Qualitative (2) Grounded theory (3) Delphi Enquiry Process	(1) Registered dietitians (2) *N* = 58
Casagrande et al. (2011) USA	To determine if dietitians' beliefs about fresh vegetable food safety predict whether they provide food safety information to their clients	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Registered dietitians (2) *N* = 327
Dauner et al. (2011) USA	To examine the processes used to improve the provision of healthy and sustainably produced food in a hospital	(1) Qualitative (2) Grounded theory (3) Semi-structured interviews	(1) Hospital food managers (2) *N* = 25
Duncan and Bergman (1999) USA	To investigate what registered dietitians know about vegetarian diets and to document their attitudes about these diets	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Registered dietitians (2) *N* = 183
Edelstein et al. (2010) USA	To determine whether nutrition professionals use eco-friendly products	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Registered dietitians and nutrition professionals (2) *N* = 127
Harmon et al. (2011) USA	To identify dietetics educators' current attitudes toward, needs regarding, and interpretations of sustainability	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Educators in dietetics programs (2) *N* = 145
Hawkins et al. (2015a) USA	To explore registered dietitians' concerns about climate change and factors that may influence practice-related behaviours	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Registered dietitians (2) *N* = 570
Hawkins et al. (2015b) USA	To discover factors associated with pro-environmental behaviours and relationships with personal or practice-based behaviours	(1) Qualitative (2) Phenomenological method (3) Semi-structured interviews	(1) Registered dietitians (2) *N* = 17
Hawkins et al. (2015c) USA	To discover how dietitians made the connection between diet, climate change, and environmental degradation	(1) Qualitative (2) Thematic analysis (3) Semi-structured interviews	(1) Registered dietitians (2) *N* = 17
Hawkins et al. (2015d) USA	To discover what skills enabled registered dietitians to adopt individual pro-environmental behaviours	(1) Qualitative (2) Thematic analysis (3) Semi-structured interviews	(1) Registered dietitians (2) *N* = 17
Heidelberger et al. (2017) USA	To investigate the behaviour of dietitians toward the promotion of sustainable agriculture	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Registered dietitians (2) *N* = 626
Hughes et al. (2014) USA	To assess dietitians' perceptions of plant-based protein and the relationships of such perceptions with demographic factors	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Dietitians (2) *N* = 136
Nuttman et al. (2020) Australia	To guide the development of health promotion and food security programs in Australia	(1) Mixed methods (2) Cross-sectional, thematic analysis (3) Surveys, interviews	(1) Health practitioners (2) *N* = 61 (phase 1), *N* = 16 (phase 2)
Robinson and Smith (2003) USA	To evaluate registered dietitians' attitudes and intentions on integrating sustainability issues into their professional practice	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Registered dietitians and experts in nutrition (2) *N* = 147
Spencer et al. (2007) USA	To determine the prevalence and correlates of US medical students' self-identification as vegetarians	(1) Quantitative (2) Longitudinal (3) Survey	(1) Medical students (2) *N* = 1849
Sulda et al. (2010) Australia	To develop a framework to guide public health nutrition actions and address factors contributing to climate change	(1) Mixed methods (2) Cross-sectional, thematic analysis (3) Survey, interviews	(1) Dietitians (2) *N* = 186

Table 2 (continued)

Authors (year) country	Main objective of the study	Study characteristics (1) Study design (2) Approach (3) Data collection tool	Participant characteristics (1) Type of participants (2) *N* (sample size)
Webber and Sarjahani (2011) USA	To determine the relevance of sustainable food systems to dietetic internship directors and associated barriers	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Dietetics program directors (2) $N = 81$
Wilson and Garcia (2011) Canada	To examine beliefs, attitudes, and behaviours about environmentally friendly practices in hospitals	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Food managers, dietitians, leaders (2) $N = 68$
Worsley et al. (2014) Australia	To determine dietitians' interest in information about sustainable agriculture and food security	(1) Quantitative (2) Cross-sectional (3) Survey	(1) Registered dietitians (2) $N = 380$

"influencing factors." This term does not refer to a statistical relationship.

Factors related to professionals' social and demographic characteristics Being vegetarian or vegan appeared to strongly influence motivation and commitment to applying sustainable nutrition principles ($n = 5$). The years of professional experience as a dietitian also appeared to play a role, as dietitians who had been practicing longer reported a lower intention to incorporate sustainable nutrition into their practice ($n = 5$). Similarly, participants' age appeared to be an influencing factor ($n = 3$): older respondents reported a lower perceived level of knowledge on sustainable nutrition and a lower tendency to search for and use this information with their clients.

Factors related to professionals' knowledge, attitudes, and values Five factors were included in this category. Professionals' level of knowledge about how to integrate sustainable nutrition into their practice was the most frequently mentioned factor in 16 studies and was described as a prerequisite for integrating sustainable nutrition. Perceiving environmental issues to be part of one's professional role ($n = 13$ studies) and professionals' awareness of environmental issues ($n = 11$) were also frequently mentioned. This highlights the need to inform and train health professionals on environmental issues. Participants also indicated ($n = 10$) that they perceived educating patients on sustainable nutrition to be very important and that their personal values and beliefs on preserving the environment had a positive influence on their practice ($n = 5$).

Factors related to professionals' skills and practices Ten factors related to professionals' skills and practices were identified. Some factors referred to barriers faced by professionals. Chief among them was a perceived lack of skills needed to integrate sustainable nutrition into practice ($n = 9$). Other important factors included the lack of access to evidence-based facts and information tools to use with patients ($n = 8$), low patient expectations and preparedness to receive information on environmental issues ($n = 7$), and lack of time to discuss environmental issues with patients ($n = 6$). In some papers, professionals reported being constrained to focus on only one or two dimensions of sustainable nutrition, which made it more manageable to integrate the issue into their practice ($n = 3$). Respondents also mentioned factors that may facilitate the integration of sustainable nutrition. These included having a practice in a setting committed to environmental issues ($n = 8$) and having past professional experiences, even modest ones, in advocating for sustainable nutrition ($n = 8$). Other facilitating factors were attending activities and events focused on sustainable nutrition ($n = 7$), access to continuous or initial training ($n = 6$), receiving support from managers ($n = 5$), and being involved in networks promoting sustainable nutrition ($n = 5$). Overall, respondents in these studies emphasized that their practical environment primarily encourages health promotion; while perceived as important, environmental issues were relegated to second place.

Factors related to practice settings and health system characteristics Six factors related to practice settings and health systems appeared to influence the integration of sustainable nutrition in practice. Promoting sustainable nutrition among the general population ($n = 11$) was mentioned as a priority in order to change worldviews and practices and to increase the legitimacy of integrating sustainable nutrition. Participants expressed the need for official guidelines on sustainable nutrition and purchasing practices, and improved labelling laws that would facilitate choices for the general population and hospital food service managers ($n = 10$). Access to financial support ($n = 8$) was also mentioned as an important factor that would help in developing tools and innovative programs encouraging sustainable nutrition. Other factors included making environmental issues a priority for professional boards ($n = 5$) and for the health system

Table 3 Factors influencing the integration of sustainable nutrition into professional practices

Factors reported in included studies (number of studies)	Number of studies in which the factor was identified as a barrier (B) or a facilitator (F) [reference number]*	Summary of findings
Related to social and demographic characteristics *n* = 10		
Being vegetarian or vegan (*n* = 5)	*B* = 2 [16, 19] *F* = 5 [5, 7, 13, 16, 19]	Current or past vegetarianism and veganism positively influenced participants' knowledge and application of sustainable nutrition in practice. However, health was the most common reason for adopting a vegetarian diet, not environmental concerns.
Number of years of professional experience (*n* = 5)	*B* = 3 [5, 11, 15] *F* = 2 [12, 15]	Dietitians who had been practicing longer were less aware of environmental issues. The odds of agreeing that climate change is an important issue declined as years of dietetic practice increased. This factor may be less influential for urban dietitians and those with higher levels of education.
Age (*n* = 3)	*B* = 1 [13] *F* = 3 [3, 13, 15]	Age had an influence on the knowledge of, search for, and use of information on sustainable nutrition. It also affected personal interest in implementing sustainable diets in personal life or professional practice.
Related to knowledge, attitudes and values *n* = 20		
Professionals' knowledge (*n* = 16)	*B* = 7 [8, 11–13, 15, 17, 20] *F* = 14 [3–8, 10–13, 15, 17, 18, 20]	Knowledge appeared to play an important role in environmental awareness and perceived ability to incorporate sustainable nutrition into practice. Most participants reported the need to have more knowledge on sustainable nutrition. A negligible percentage of dietitians reported that sustainable nutrition had been part of their dietetic curriculum.
Commitment to environmental issues as part of their professional role (*n* = 13)	*B* = 3 [12, 14, 20] *F* = 11 [3, 6–8, 12–15, 17, 18, 20]	Most dietitians perceived that addressing climate change and sustainable nutrition was appropriate to their practice. Practice guidelines supporting their advocacy and awareness raising roles were needed. However, dietitians felt that providing information on the environmental impacts of food was less important than providing information on health and food security issues.
Professionals' awareness of environmental issues (*n* = 11)	*B* = 5 [4, 6, 7, 14, 20] *F* = 10 [2, 4–8, 10, 13, 16, 20]	Climate change and sustainable nutrition were perceived as very important issues. Personal and professional beliefs on these issues were described as inseparable. Information from credible and authoritative sources influenced their awareness. They reported a lower awareness of the contribution of individual aspects of sustainable nutrition.
Importance given to informing patients and general population (*n* = 10)	*B* = 6 [1, 12–15, 19] *F* = 5 [14–17, 19]	Educating clients on sustainable nutrition and environmental issues was perceived as highly important, but only a small proportion of dietitians actually counselled their clients on these issues. Priority was given to informing clients about nutritional health recommendations, given poor food literacy and poor quality food labelling.
Personal values and beliefs (*n* = 5)	*B* = 1 [8] *F* = 5 [8–10, 13, 15]	Past personal experiences with nature and the environment appeared to influence environmental awareness and concern. A sense of personal gratification was experienced when engaging in pro-environmental behaviours at work.
Related to skills and professional practices *n* = 19		
Perceived skills and self-efficacy (*n* = 9)	*B* = 3 [12, 15, 20] *F* = 5 [5, 8, 11, 17, 18]	Participants reported the need to increase their skills in sustainable nutrition. Perceived required skills were a good understanding of the issue, the ability to use evidence-based research, and an interest in innovation and professional development. Self-efficacy was a strong predictor of their intention to promote a plant-based diet.

Table 3 (continued)

Factors reported in included studies (number of studies)	Number of studies in which the factor was identified as a barrier (B) or a facilitator (F) [reference number]*	Summary of findings
Having access to evidence-based facts and information tools to use in practice ($n = 8$)	$B = 3$ [4, 18, 20] $F = 7$ [1, 5, 7, 11, 17, 18, 20]	Dietitians reported needing tools to make efficient use of client education time and recommended establishing a uniform message on sustainable nutrition. The proliferation of competing health and sustainability messages was perceived as potentially confusing for clients. Dietitians expected their professional board to provide them with teaching resources.
Explicit priority given to environmental issues in the practice setting ($n = 8$)	$B = 6$ [4, 12, 14, 15, 17, 19] $F = 3$ [4, 10, 13]	The low priority given to climate change in the practice setting was described as a barrier. Dietitians working in health care settings reported lower positive attitude and behavioural control and tended to give priority to health-related messages. Those working in community or educational settings were more positive about addressing environmental issues.
Previous professional experiences of advocating for sustainable nutrition ($n = 8$)	$B = 5$ [6, 8, 12, 14, 19] $F = 5$ [1, 9, 12, 13, 19]	Some dietitians reported that they currently advocate for sustainable nutrition in their practice; most of these dietitians were also personally making the shift to a more sustainable diet. Dietitians mainly leaned toward buying organic and locally grown food.
Patients' expectations and interests ($n = 7$)	$B = 5$ [4, 7, 12, 13, 15] $F = 3$ [3, 5, 15]	Dietitians saw a greater interest in healthy, local, and organic foods and an increase in vegetarian clients. However, they reported that most clients are mainly focused on health and express low interest in replacing animal proteins. A lack of client interest and ability to understand information negatively affected dietitians' motivation.
Attending events and activities focused on sustainable nutrition ($n = 7$)	$B = 2$ [4, 17] $F = 4$ [7, 17, 18, 20]	Dietitians reported not being well informed of sustainable nutrition activities or that the activities they are aware of are not focused on sustainable nutrition. Directors of dietetics programs reported initiating activities such as field trips and webinars with guest speakers.
Time ($n = 6$)	$B = 6$ [3, 4, 12, 15, 18, 19] $F = 3$ [3, 12, 18]	Participating professionals mentioned a lack of time for training on how to apply sustainable nutrition in practice. Dietitians reported a lack of time to teach patients about climate change when addressing health issues is a priority.
Resources for continuing and initial education ($n = 6$)	$B = 3$ [1, 7, 18] $F = 5$ [7, 13, 17, 18, 20]	Public health officers expected to be provided with facts and resources supporting practice changes. Dietitians expected online training, factsheets, e-mail updates, scientific articles, webcasts, and professional development courses. Sustainable nutrition should also be incorporated into dietetics training programs.
Encouragement from managers ($n = 5$)	$B = 4$ [12, 15, 17, 19] $F = 1$ [4]	Lack of manager support negatively affected health practitioners in their ability to incorporate sustainable nutrition. Managerial openness to innovation was reported as a facilitating factor, as was a sense of empowerment and ownership over decisions.
Involvement in networks promoting sustainable nutrition ($n = 5$)	$B = 2$ [1, 18] $F = 4$ [1, 4, 13, 18]	Being involved in networks promoting sustainable nutrition allows mutual support, collective responsibility, and improved project building and dissemination of information. Pro-sustainable nutrition networks were described as facilitating the integration of climate change mitigation activities into practice.
Focusing on just a few dimensions of sustainable nutrition ($n = 3$)	$B = 3$ [4, 14, 19] $F = 1$ [19]	Some dietitians reported focusing on just those aspects of sustainable nutrition that are the most accepted or easy to apply. Priority was given to organic, locally grown food or replacing animal proteins. Other principles of sustainable nutrition were rarely mentioned.

Table 3 (continued)

Factors reported in included studies (number of studies)	Number of studies in which the factor was identified as a barrier (B) or a facilitator (F) [reference number]*	Summary of findings
Related to health system and practice settings *n* = 14		
Promoting sustainable diets among the general population (*n* = 11)	*B* = 3 [1, 7, 20] *F* = 6 [4, 6, 7, 9, 14, 17]	Respondents recommended that the general population should be better informed about how to reduce the adverse effects of food production and consumption on climate change. This could be done through public health campaigns. A balanced approach was recommended with the inclusion of health, social and economic aspects of sustainability.
Providing guidelines on sustainable nutrition and lobbying for improved labelling laws (*n* = 10)	*B* = 4 [1, 6, 12, 18] *F* = 6 [1, 2, 4, 6, 14, 17]	Participants reported a need for operational guidelines on food sustainability and tools to translate it into action. Farmers and manufacturers should be obliged to provide the necessary sustainable nutrition information for consumers to be able to identify eco-friendly products. Inconsistent and contradictory environmental messaging was described as a barrier.
Enhanced financial support (*n* = 8)	*B* = 6 [4, 6, 12, 15, 18, 19] *F* = 3 [4, 8, 18]	The lack of financial support was reported as a barrier. For health professionals, additional resources were needed to develop and provide training on sustainable nutrition. In hospital food services, the higher cost of eco-friendly products was a barrier. Increased funding would enable more research and program development opportunities.
The role of professional associations and academies (*n* = 5)	*B* = 2 [8, 12] *F* = 5 [7, 8, 12, 13, 17]	Perceived support from their professional association influenced whether or not dietitians included sustainable nutrition in their practice. Dietitians felt that adequate support was not provided, and would use teaching resources on this topic if these were provided to them.
Health system's priorities (*n* = 4)	*B* = 3 [1, 17, 20] *F* = 3 [1, 2, 17]	Participants agreed that the health system should take up the role of addressing climate change. The lack of attention given to climate change was described as the result of climate change ranking low among organizational priorities. Dietitians stressed that advocacy messages should give equal weight to ecological, health, social, and economic outcomes.
Strengthening partnerships (*n* = 3)	*B* = 1 [4] *F* = 2 [1, 17]	Creating strong partnerships and networks was identified as critical. Local councils, environmental experts, the agricultural community, and food distribution and health centres should better understand each others' cultures to foster beneficial relationships.

*The reference associated with each identifying number is reported in the synthesis section (first paragraph)

in general (*n* = 4). Given that sustainable nutrition challenges are multisectoral, strengthening partnerships with other sectors in the food system and with municipalities was also reported to be an influencing factor (*n* = 3). Participants in the reviewed studies mentioned the need for decision-makers and public organizations to explicitly promote sustainable nutrition and develop clear policies and guidelines in this area. Legitimizing the integration of sustainable diets at the organizational level helps ensure that professionals' actions are not perceived to be merely the result of individual preferences.

Factors influencing food managers and public health officers

Most studies included in this review were conducted among dietitians working in private practice, primary care clinics, or hospitals. Only two studies were conducted with food supply managers (Dauner et al. 2011; Wilson and Garcia 2011) and just one with public health officers (Carlsson et al. 2017). As documenting the views of these professionals was among our objectives, the specific findings of these are presented here. Hospital food service managers reported a lack of consumer awareness about sustainable nutrition and that, in comparison, much more attention was given to the impacts of food on human health (Dauner et al. 2011; Wilson and Garcia 2011). They reported that this factor contributes to the challenges of convincing consumers of the merits of implementing sustainable nutrition. Clearer labelling and improved accuracy of available product information were also mentioned as needs. Food service managers reported focusing on just certain

Table 4 Authors' priority recommendations for promoting sustainable nutrition in professional practice

Priority recommendations*	Number of studies	Reference numbers**
Providing evidence-based facts and information tools	6	1, 5, 7, 17, 18, 20
Promoting sustainable diets among the general population	7	1, 3, 4, 8, 17, 19, 20
Increasing professionals' knowledge	6	3, 12, 14, 15, 19, 20
Providing opportunities for continuing and initial education on sustainable nutrition	3	13, 17, 18
Improving guidelines on sustainable nutrition and food labelling	6	1, 2, 6, 14, 19, 20
Increasing professionals' self-efficacy	4	8, 10, 12, 18
Increasing the importance given to informing patients on this issue	4	3, 5, 15, 19
Increasing the number of professionals who perceive addressing environmental issues to be part of their professional role	4	6, 11, 13, 19
Providing sustainable nutrition events and activities	5	1, 4, 7, 18, 19
Providing opportunities to join networks on this issue	3	1, 4, 20

*Priority recommendations that were mentioned at least three times were reported

**The reference associated with each identifying number is reported in the synthesis section (first paragraph)

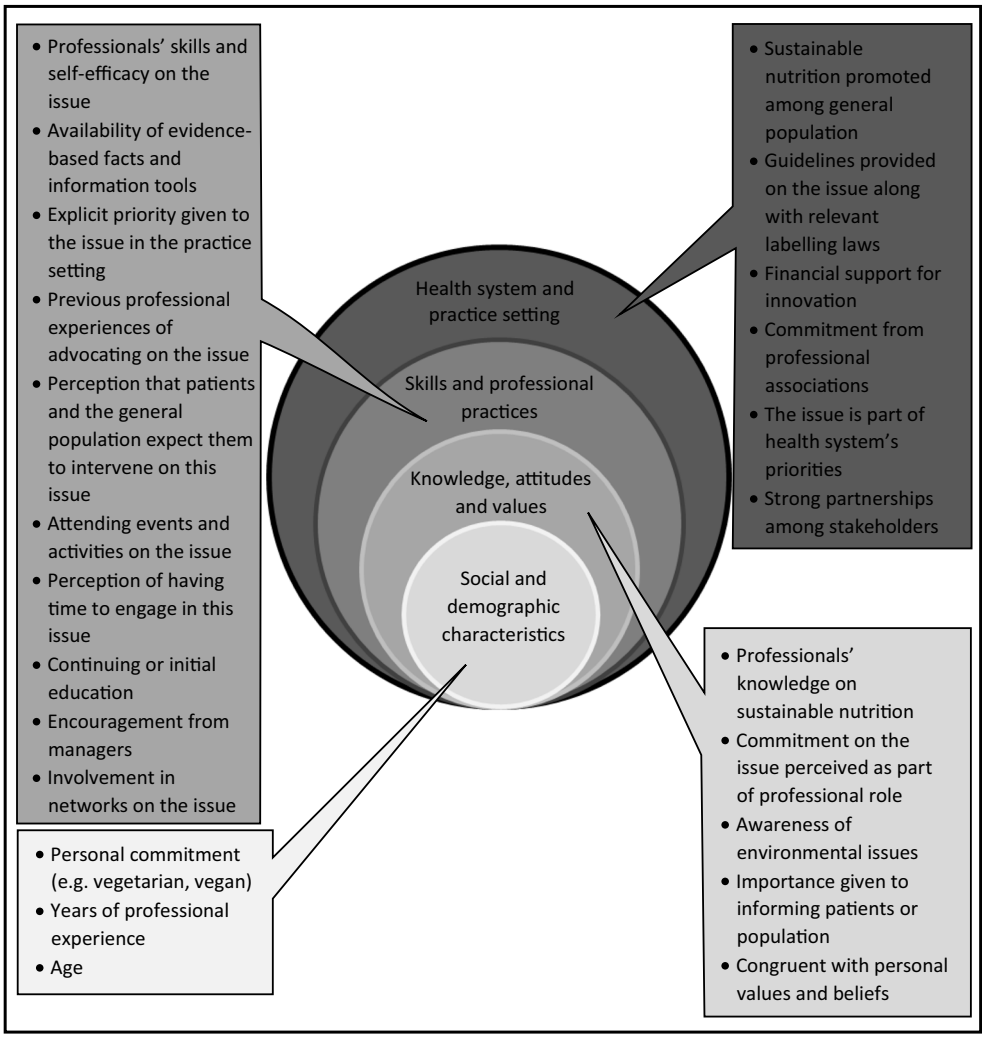

Fig. 2 Framework depicting the multiple factors influencing the integration of sustainable nutrition into health-related professionals' practice

aspects of sustainable nutrition, such as purchasing local or organic products, on account of cost constraints. They underlined the need to identify priority targets for sustainable nutrition and to develop specific indicators for monitoring progress in hospitals. Staff empowerment, managers' openness to trying new things, and close partnerships with suppliers and producers appeared to play a major role in facilitating the integration of sustainable nutrition. In the study conducted with public health officers (Carlsson et al. 2017), respondents were especially concerned with identifying what changes should be targeted in the food system through a concerted process with local stakeholders. They also reported a need for tools to systematically measure and track these changes at the local food system level. They mentioned the importance of using common metrics such as the percentage of locally or sustainably sourced foods.

Authors' top recommendations for promoting the integration of sustainable nutrition into professional practice

The authors of the studies included in this review identified several high-priority recommendations to foster the integration of sustainable nutrition into practice. These recommendations, viewed as the most essential to the integration of sustainable nutrition, are summarized in Table 4. Each was cited one to seven times in the included studies. The recommendations have been classified into three categories. The first category covers recommendations related to improving knowledge and skills and includes increasing professionals' knowledge ($n = 6$) and self-efficacy ($n = 4$), as well as encouraging professionals to see promoting sustainable nutrition as not only important ($n = 4$) but also as part of their role ($n = 4$). The second category covers resources to help professionals integrate sustainable nutrition into their practice, including access to evidence-based, approved factsheets and information tools ($n = 6$), activities and events ($n = 5$), professional training ($n = 3$), and networks ($n = 3$), all on the topic of sustainable nutrition. The last category includes recommendations to help change the social environment. Promoting sustainable nutrition among the general population ($n = 7$) was strongly recommended in order to support broad social change, which would in turn support specific improvements, such as sustainable nutrition guidelines for professionals, improving purchasing practices, and improving nutrition labelling information rules ($n = 6$).

Discussion

This mixed-methods systematic review explored factors influencing health professionals, public health officers, and hospital food service managers in integrating sustainable nutrition into their professional practice. This study aimed to identify promising avenues in order to develop an action plan to promote sustainable nutrition in health-related organizations. Studies included in this review were conducted in Western countries and mostly published after 2000, commensurate with the increased awareness of our ecological emergency. The fact that almost all studies were conducted with dietitians may indicate that the potential contribution of other health professionals (e.g., physicians, nurses), public health officers, and food supply managers is largely understudied. To the best of our knowledge, this is the first systematic review to explore the barriers and facilitating factors to the integration of sustainable nutrition in health-related organizations. A total of 25 factors were documented in the present review along with ten priority recommendations made by the authors of primary studies. Several lessons can be drawn from these results.

First, promoting sustainable nutrition in health-related institutions is a multidimensional phenomenon with a wide variety of influencing factors. Indeed, influencing factors exist at the societal level (e.g., campaigns influencing social norms and values), the political level (e.g., policies issued by governmental, agricultural, municipal, and health authorities), the industrial level (e.g., food and agriculture, distribution, and marketing), the organizational level (e.g., updating processes and procedures in practice settings), and the educational level (e.g., available professional training). This suggests that effective actions and intervention strategies should not only focus on professionals working in health-related institutions but should target several levels (Johnston et al. 2014; Mason and Lang 2017). Based on the main results of this review and guided by ecological frameworks (e.g., Story et al. 2008), Fig. 2 schematizes the levels and factors that could be advantageously targeted to promote sustainable nutrition in health-related institutions.

Although participants perceived sustainable nutrition to be an important issue, they reported that they needed greater institutional support to enable their involvement. This may take the form of updated practice guidelines and action plans issued by practice settings, professional boards, public health institutes, or ministries of health. Common definitions, principles, monitoring tools, and certification programs could also be useful. In the present review, institutionalizing commitment to the environment and to sustainable nutrition appears crucial. This has been previously conceptualized by Scott's institutional theory (Scott 2005), which underlines that practices must be seen as legitimate to be institutionalized and that only institutionalized professional practices are consistently implemented by organizations and individuals (Deegan 2014). Nevertheless, as shown by the vast literature on the institutionalization of sustainability practices, many organizations tend to adopt these practices (e.g., policies, certifications, guidelines) symbolically and superficially to improve organizational legitimacy rather than to substantially change internal practices through the active support of managers, the

allocation of appropriate resources, and the development of competencies (Testa et al. 2018; Rodrigue et al. 2013).

Participants also reported focusing their efforts on one or two dimensions of sustainable nutrition, mainly encouraging people to choose local or organic foods and, to a lesser extent, plant proteins. Other aspects of sustainable nutrition, such as reducing food waste, choosing foods with less packaging, cultural acceptability, and affordability were largely absent. These results shed light on the complexity of integrating the various recommendations for sustainable nutrition along with its guiding principles. As mentioned by Wegener et al. (2018), current practices are shaped by the tendency of most health institutions to include only a few recommendations related to sustainable nutrition based on their hierarchy of the guiding principles; for instance, Canada's food guidelines put an emphasis on the consumption of plant-based proteins, fruits, and vegetables. This may also suggest that changes in practice progress gradually or, alternatively, it may be indicative of a low level of involvement in and a narrow vision of sustainable nutrition. Participants also reported the absence of guidelines about the degree to which they are expected to integrate sustainable nutrition into their professional practice, leaving the door open to minimal investment. In this context, it seems necessary to develop and distribute guidelines describing the expected practices for different professions and providing indicators to track progress. In a large review of health promotion programs, the degree to which expected practices were set, along with the extent to which the necessary organizational conditions were implemented, strongly affected program outcomes (Durlak and DuPre 2008).

Sharing opportunities, information, and teaching tools on sustainable nutrition and providing training were identified as priorities. Key definitions and messaging on sustainable nutrition should be established by consensus, harmonized, and disseminated in health-related organizations through these activities and tools (Wegener et al. 2018). Training programs should also support professionals regarding the development of leadership roles and advocacy skills, facilitating cross-sectoral collaboration, and applying reflexive and social justice approaches (Carlsson et al. 2019). This may have the potential to contribute to the necessary institutionalization of sustainable nutrition. According to a previous review, the main determinants of whether health professionals adopt a given practice were whether they perceived themselves to have sufficient knowledge to do so, saw more benefits than disadvantages to its adoption, perceived themselves as capable, expected the approval of others, and reported themselves as motivated to adopt it (Godin et al. 2008). All these determinants can be effectively addressed through professional activities and tools (Forsetlund et al. 2009). Nevertheless, past studies have also shown that training can only change professional practices if several organizational conditions are met, including managerial support and explicitly defining the task and planning its integration into professional routines (Cheng and Hampson 2008; Ma et al. 2018; Yuriev et al. 2018).

Finally, the importance of increasing the general population's awareness of sustainable nutrition was highlighted. Participants reported their need for social approval and the desire for their activities related to sustainable nutrition to be perceived as legitimate. In this context, information campaigns are recommended to ensure congruence between social expectations and the values and practices promoted by health organizations (Deegan 2014). This has the potential to encourage people to be open to, and even support, sustainable nutrition initiatives by professionals. It is, however, important to note that information campaigns generally benefit from taking the socio-cultural characteristics of the targeted population into account. According to the several studies, younger, more urban and more privileged populations tend to be more motivated to favour sustainable nutrition (Anguelovski 2015). The adoption of an inclusive, empowering and non-stigmatizing population-based approach aimed at reducing socio-structural inequalities in sustainable nutrition is therefore a key concern (Godfray et al. 2010).

This review followed a rigorous methodology for mixed-methods systematic reviews. Nevertheless, several limitations should be mentioned. First, the review focused on the views of various stakeholders in the health system and excluded interventional studies. However, some professionals, notably hospital food service managers, seem to more often have been the focus of interventional studies. In addition, only articles written in English or French were considered; this language restriction may have biased the results. Second, although most studies reported the proportion of participants by the type of workplace (e.g., public versus private practice settings), results were not systematically provided based on these categories and therefore prevented us from conducting analysis using these variables. Finally, of the 20 papers included, six came from just two research programs (Hawkins et al. 2015a; Hawkins et al. 2015b, 2015c, 2015d; Carlsson et al. 2019; Carlsson et al. 2017). This may have had led to overestimating some results.

Conclusion

This review allowed us to identify several promising avenues to facilitate the integration of sustainable nutrition into professional practices. There is a clear need to institutionalize professional practices surrounding sustainable nutrition, which requires the support of the highest health institutions in terms of planning and implementing strategies. Professionals also need to be better guided in their practice through training activities, practice recommendations, and tools both for themselves and for patients. At the same time, initiatives are needed in order to better inform the population about environmental challenges and sustainable nutrition's indispensable contribution to protecting ecosystems. These results may notably provide support to projects aimed at integrating sustainable nutrition across Canadian provinces and territories.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

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