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School-based nutrition interventions for Indigenous children in Canada: A scoping review

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Abstract

Background Indigenous children in Canada (First Nations, Inuit, and Métis) are disproportionally affected by nutrition-related chronic diseases such as obesity and diabetes. Comprehensive school-based nutrition interventions offer a promising strategy for improving children's access to healthy foods and sustaining positive eating behaviors. However, little is known about school-based nutrition interventions for Indigenous children. The objectives of this scoping review were to identify school-based nutrition interventions for Indigenous children in Canada and describe their components. Methods The scoping review consisted of searches in seven peer-reviewed databases and a general web search for grey literature. Eligibility criteria were applied by two reviewers, and data were extracted and charted by one reviewer using components of comprehensive school health (social and physical environment, teaching and learning, policy, partnerships and services) and additional components with relevance to Indigenous interventions (cultural content, Indigenous control and ownership, funding source, evaluation). Thematic analysis provided a description of interventions. Results Sixty-five sources of evidence, representing 34 unique interventions met the inclusion criteria. The majority (97%) of interventions targeted the social and physical environment, most often by offering food programs. Over half of interventions also incorporated teaching and learning (56%) and partnerships and services (59%), but fewer included a policy component (38%). Many interventions included a cultural component (56%) and most (62%) were owned and controlled by Indigenous communities. Finally, over half of interventions disclosed their source(s) of funding (59%), but less than half (41%) included an evaluation component. Conclusions The review suggests that school-based interventions for Indigenous children can be more comprehensive by incorporating culturally-relevant nutrition education and professional development opportunities for teachers, written school nutrition policies, and activities that actively engage families and community members. The continued focus on Indigenous control and ownership and incorporation of content specific to individual communities may enhance cultural relevancy and sustainability of interventions. Furthermore, there is a need to increase intervention evaluation and the sharing of resources related to funding. These recommendations may be used by communities, as well as by researchers and professionals working with communities, in developing comprehensive school-based nutrition interventions to improve the eating behaviors of Indigenous children.

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Keywords

Indigenous, First Nations, Inuit, Metis, school, nutrition, scoping review, intervention

Background

Indigenous communities in Canada (i.e., First Nations, Inuit, and Métis) face significant obstacles to healthy eating due to sociocultural and environmental barriers, including low income, a high prevalence of household food insecurity, and the expense of nutrient-dense foods (1–3). Unique to Indigenous peoples, these issues exist within a larger macro-context of historical colonization, assimilation policies, and forced removal from traditional lands (4). For instance, the dispossession and industrialization of traditional lands has resulted in the loss of knowledge and skills related to land-based food practices (e.g., hunting, gathering, and horticulture) and forced dependence on highly processed, nutrient poor market foods (5). Due in large part to these barriers, the diets of many Indigenous children are energy-dense and low in nutrient dense foods like fruits and vegetables (6–8). These poor dietary patterns contribute to a high risk of nutrition-related chronic diseases like obesity, diabetes, and cardiovascular disease (9). Effective strategies to improve food environments and eating behaviors of Indigenous children that consider the multiple barriers that Indigenous communities face are needed to ensure that Indigenous children are able to attain optimal nutrition and health.

Schools are an important setting to target nutrition interventions to promote and support healthy eating, considering the time that children spend in schools during their formative years (10). Research supports the positive impact that school-based nutrition interventions – such as breakfast or lunch programs – can have on the diet, learning, and health outcomes of Indigenous children (11–14). There is also evidence that comprehensive, multi-component school-based interventions hold greater potential in promoting and supporting positive health changes in the long-term than single-component nutrition interventions (12,15–20).

Comprehensive School Health (CSH) is an internationally-recognized school-based health promotion approach that integrates multiple aspects of the school environment through four mutually reinforcing components into a single intervention (social and physical environments, teaching and learning, school policy, and partnerships and services). Evidence from evaluations in non-Indigenous populations have demonstrated that CSH interventions have resulted in increased physical activity, improved dietary habits, and decreased rates of obesity and chronic disease among children (21–24). Comprehensive school-based nutrition interventions may also be effective in Indigenous settings by increasing children's access to healthy foods and sustaining positive eating behaviors (12,25). However, there is limited evidence concerning school-based nutrition interventions in Indigenous communities in Canada.

In 2008, The Assembly of First Nations performed an environmental scan of school nutrition programs and policies for children in First Nation community schools across Canada. Of the 47.9% of schools that responded to the survey (n=303), 86.7% had a school nutrition program (e.g., breakfast, snack, and/or lunch program) and nearly two-thirds (62.3%) had a school nutrition policy (12). More recent reviews have identified school-based interventions that aim to improve nutrition knowledge, food preferences, and/or health in Indigenous communities; however, these reviews have largely focused on

evaluating the effectiveness and impacts of interventions rather than describing their components (25–27). Describing the content and scope of interventions is an important next step in developing evidence-based comprehensive school-based nutrition interventions to improve eating behaviors in Indigenous communities.

The primary objective of this scoping review was to identify school-based nutrition interventions for Indigenous children in Canada. The second objective was to describe the main components of the identified school-based nutrition interventions for Indigenous children. Overall, this review was intended to identify gaps and provide recommendations for the development of comprehensive school-based nutrition interventions to optimize nutrition and health outcomes for Indigenous children.

Methods

This scoping review was conducted following the methodological framework developed by Arksey and O'Malley (28) which included identifying relevant information sources, information source selection, charting the data, and analyzing and summarizing the data. The review is reported following the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (29). Ethics approval was not required as the review relied solely on publicly available information.

Identifying relevant information sources

With the assistance of a research librarian (JT) at the University of Alberta, an initial search was conducted to develop and refine the search strategy for the scientific literature. Searches were then conducted by two research librarians (JT and LH) using the following databases: Medline (Ovid), ERIC (Ovid), CINAHL Plus with Full Text (EBSCO), Agricultural & Environmental Sciences (Proquest), Academic Search Complete (EBSCO), Bibliography of Native North Americans (EBSCO), and Dissertations and Theses Global (Proquest). Searches employed both controlled vocabularies, such as Medical Subject Headings (MeSH), and keywords representing concepts such as: (Indigenous or Amerindian) AND (schools or kindergarten) AND (nutrition or diet) AND (Alberta or British Columbia). The search for the scientific literature covered articles published between January 1, 2000 and February 25, 2019). No limiters or facets were used, and search strategies were adapted for each database (see Additional File 1).

In an effort to minimize the risk of omitting relevant sources of evidence, one researcher (CG) conducted a search of the grey literature on the Internet using different combinations of key search terms (30). Grey literature are documents not formally published in academic sources (e.g., peer-reviewed journals), and include information sources such as newspapers, websites, conference proceedings, and unpublished research (e.g., theses) (30). First, a filter was applied to limit the Google search to the region of Canada and to the English language. Next, the first ten pages of each search's hits (representing 100 results) were reviewed, using the title and 2-3 lines of text underneath. This number of pages allowed the search to retrieve the most relevant hits while still being a feasible amount to review (30). Potentially relevant records were 'bookmarked' in the web browser and later entered into an Excel spreadsheet for further screening. For each search strategy, the search terms, number of results retrieved and screened, and date of the search (January 30, 2019) were recorded (see Additional File 2). The reference lists of all included sources of evidence were hand-searched by one reviewer (CG) to identify additional relevant sources.

Selection of sources of evidence

Basic eligibility criteria were defined *a priori* (Table 1) and were based on sources of evidence having a publication status that the reviewers considered recent enough to be relevant, being published in a language that both reviewers could read and containing information that specifically met the research objectives. To test reviewer agreement of eligibility criteria, two reviewers (CG and RB) independently reviewed a random selection of sources of evidence from the scientific (n=10) and grey (n=10) literature. Their level of agreement was 100%. At this stage, the reviewers determined that the date criteria would not apply to websites. The reviewers felt it was unlikely that a website would be running if it was outdated by over a decade, as many website hosting platforms require a fee for maintenance. Therefore, if a website was available at the time of the review,

it was considered eligible for review and selection, whether it had a date listed on its pages or not (no website had a date listed that was prior to January 1, 2000).

In the first stage of selection, two reviewers (CG and RB) applied the eligibility criteria to determine the relevancy of sources of evidence identified in the scientific literature. First, the reviewers screened the title and abstracts for relevancy and copies of the full text were obtained for those that appeared to fit the eligibility criteria. If the relevance of a source of evidence was unclear from the abstract, or if reviewers had discrepant assessment at this stage, the full text was obtained. In the second step, each reviewer read the full text of each article to decide whether it should be chosen for inclusion in the review. Discrepancies between reviewers were discussed, and a third opinion (NDW) was sought for two of the scientific literature sources of evidence.

The grey literature search followed a one-step process whereby sources of information were screened by each reviewer in full to determine both relevancy and inclusion. This one-step determination was followed out of necessity, as the majority of sources of evidence were websites that did not have an abstract or table of contents to screen. There was 100% agreement between the reviewers for all grey literature sources of evidence.

Charting and analyzing the data

The extraction form was developed by one reviewer (CG) in excel and reviewed by the study team for relevance and appropriateness. The extraction fields included an identifier, intervention type (single school or multiple school), intervention name, author and year, location, school name, grade(s) served, and target cultural group (i.e., First Nations, Inuit, Métis). The extraction fields also included eight school-based nutrition interventions components: four components of CSH (23,31) and four additional components that may be important to interventions in Indigenous communities (25–27,32) as described in Table 2.

The extraction form was pilot tested by two reviewers (CG and RB) with a random sample of 5 sources of evidence (from the scientific or grey literature) to ensure all relevant data were captured. As the goal of this review was to provide an overview of the existing literature regardless of quality, a formal appraisal of the methodological quality of sources of evidence included in the review was not performed (28,29,33).

To organize the data, characteristics of the included interventions and key information relevant to the review objectives were extracted and charted independently by one reviewer (CG) using the extraction form (Additional File 3). Only data that were relevant to nutrition were extracted (i.e., information about physical activity interventions was not extracted), consistent with the *a priori* objectives of the review. Data extracted about the same intervention described in multiple articles were combined.

Thematic analysis was used to provide an overview of the identified interventions (34). To describe the comprehensiveness and scope of the interventions, the reviewer drew upon the four components of CSH and the four supplementary components of Indigenous school-based nutrition interventions that were included as extraction fields. These eight components were used as both deductive and inductive themes to describe the specific characteristics of each intervention.

Results

A total of 65 sources of evidence were included in the review, representing 34 unique nutrition interventions (11-14,19,20,35–93) (Figure 1). Of these, 14 (41%) were implemented in a single school and 20 (59%) were implemented in more than one school. Nine interventions (26%) included each of the four aspects of CSH, and five interventions (15%) included the four supplementary components identified as important in school-based nutrition interventions for Indigenous children. Four interventions (12%) included all eight components. Twenty-four interventions targeted First Nations populations (70%), four targeted Inuit populations (12%), and one targeted Métis populations (3%). One intervention (3%) targeted more than one Indigenous population (First Nations and Métis). Four interventions (12%) did not specify a target group; rather, they broadly indicated being implemented in Indigenous or Aboriginal communities. Fifteen interventions (44%) were implemented in provinces in Eastern Canada (Newfoundland and Labrador, New Brunswick, Nova Scotia, Ontario, Prince Edward Island,

Quebec), 13 interventions (38%) in provinces in Western Canada (Alberta, British Columbia, Manitoba, and Saskatchewan), and four (12%) in the Territories (Northwest Territories, Yukon, and Nunavut). One was a national intervention in several provinces, and one was in an unspecified location.

Findings related to the four components CSH (social and physical environments, teaching and learning, school policy, and partnerships and services) and the four supplementary components of Indigenous school-based nutrition interventions that were examined (cultural content, Indigenous control and ownership, funding source, evaluation) are described in detail below.

Social and physical environment

Thirty-three interventions (97%) included one or more social and physical environment component. Seven interventions (21%) contributed to the social environment by providing healthy eating messages in newsletters or websites, or by displaying posters in the school that promoted healthy eating. For example, the Hillside Elementary School and Greenwood Elementary School Active Schools programs displayed posters in classrooms that promoted healthy lifestyles and sent newsletters home that included healthy recipes (68). To encourage both healthy relationships and healthy eating, three interventions (9%) included community feasts. Three interventions (9%) offered student cooking classes or community kitchens, where children learned about healthy eating, practiced cooking skills, and enjoyed nutritious meals. In addition, four interventions (12%) included a peer-mentoring component in which younger students learned about healthy eating from older peers. For example, the Aboriginal Youth Mentorship Program (AYMP) was an after-school peer mentoring program that included healthy snack and nutrition education components (43,48). Staff modelling was also recommended by one intervention (3%), which specifically encouraged staff to portray and model healthy eating and positive attitudes towards healthy eating.

Most interventions also included physical components that increased students' access and exposure to healthy food choices. The majority of interventions (n=25, 74%) offered food programs, with some of them offering breakfast, lunch, and snack (n=6, 24%), breakfast solely (n=4, 16%), breakfast and snack (n=1, 4%), breakfast and lunch (n=3, 12%), lunch solely (n=1, 4%), lunch and snack (n=1, 4%), and snack solely (n=8, 32%). One intervention (3%) mentioned offering student nutrition programs but did not specify the meal(s) that were included. Three interventions (9%) mentioned student access to a canteen stocked with healthy snacks, and two schools (6%) had vending machines with healthy options. Six interventions (18%) included a school or community garden, and five interventions (15%) included a nutrition awareness campaign or contest. For example, Elsipogtog First Nation School in New Brunswick hosted a healthy snack challenge, in which students who ate a fruit or vegetable during snack time were entered into a draw and had a chance to win a fruit basket (47).

Teaching and learning

One or more teaching and learning components were used in 19 interventions (56%). Fifteen interventions (44%) included a classroom education component in which discussions of healthy food choices were incorporated into the curriculum. The Kahnawake Schools Diabetes Prevention Project (KSDPP) in Quebec, for example, implemented a comprehensive education program for diabetes prevention that included lessons on balanced meals and healthy snacks, the benefits of healthy eating, factors that influence eating habits, and food label reading (37). Two interventions (6%) incorporated Indigenous land-based learning (i.e., hunting and fishing) into the curriculum. Four interventions (12%) offered a gardening program in which students learned to plant and harvest vegetables and fruits in the community or school gardens. Finally, three interventions (9%) offered professional development opportunities to teachers and staff related to providing nutrition education.

Policy

Thirteen interventions (n=13, 38%) included a policy component; however, the scope and content of policies was highly variable. Five interventions (15%) banned or actively discouraged junk food items (e.g., high fat and high sugar foods) from being brought to school. For example, Chief Harold Sappier Memorial Elementary School in New Brunswick discouraged parents from packing foods like potato chips, candy, and pop in student lunches in an effort to eliminate junk food from the school environment (89). Four interventions (12%) included food policy guidelines that outlined appropriate foods to serve in school food programs or sell in school vending machines. For example, the Kashechewan snack program in Ontario included

written guidelines that outlined categories and frequency of foods to be served in the school (51). Two interventions (6%) stated that they were compliant with national and/or provincial guidelines, and one intervention (3%) mentioned having a healthy food policy but did not provide any details about the policy content. Finally, the nutrition policy implemented as part of KSDPP targeted a wide range of social and environmental factors to promote healthy food choices, including recommendations for staff, classroom celebrations, and eating environments (62).

Partnerships and services

Twenty interventions (59%) included one or more partnerships and services component(s). Six interventions (18%) included a parent and community engagement component in which school nutrition activities were reinforced and supported by activities that engaged families and the community-at-large. For example, Yukon Food for Learning encouraged volunteer involvement in delivering school nutrition programs (93). Two interventions (6%) also specifically mentioned engaging with Elders – or persons recognized for their wisdom, experience, and knowledge – who played a role in delivering nutrition education curricula by sharing their knowledge of cultural activities and traditional foods.

Sixteen interventions (47%) included partnerships with local health and social organizations, local businesses, and national health promoting agencies. For example, Zhiiwapenewin Akino'maagewin: Teaching to Prevent Diabetes (ZATPD) in Ontario was implemented in partnership with several schools, local stores, and health and social services in order to extend its reach in the community (56,57,80). Three interventions (9%) also specifically connected with dietitians or nutritionists, who assisted in planning school food program menus or provided individualized counselling for staff, students, and parents.

Cultural content

Nineteen interventions (56%) included one or more cultural components. Ten interventions (29%) included traditional foods – such as bannock (a quick bread) and wild game meat – in the schools' food programs or the education curriculum. Four interventions (12%) incorporated traditional Indigenous ways of learning, such as learning through observation and practice, storytelling, and role modeling. Six interventions (18%) mentioned making culturally appropriate adaptations to education curricula and/or having community members review education materials for cultural sensitivity and relevance. Cultural adaptations included using Indigenous characters in stories and incorporating traditional stories and foods in lessons.

Indigenous control and ownership

Twenty-one interventions (62%) included a component in which the local community was actively involved in developing, implementing, and/or evaluating interventions. Seven interventions (21%) included information regarding programs or services being community initiated, driven, and/or developed. For example, the National Aboriginal Nutrition Program followed a community-led approach in which key stakeholders – including teachers, school staff, parents, and community members – collaboratively coordinated school nutrition activities (40). Fourteen interventions (41%) specified using participatory models of research (i.e., participatory action research and community-based participatory research) in which academic researchers and community members worked in collaboration. For example, Kipohtakaw Education Centre in Alberta developed, implemented, and evaluated both a school nutrition policy and gardening intervention through a community-based participatory research approach involving an equitable collaboration between community members and University researchers (53,55,70,71,91,92,94).

Funding source

Twenty interventions (59%) reported one or more sources of funding. Twelve interventions (35%) received funding from donations, sponsorships, or funding from diverse organizations (e.g., corporations, companies, and charitable foundations). Examples included the Heart and Stroke Foundation of Canada, the Danone Institute of Canada, Canadian Feed the Children, ONEXONE, and Breakfast for Learning. Nine interventions (26%) were supported by research grant funding, including the Canadian Institutes of Health Research and University Departments. Regional and federal funding (e.g., Health Canada's First Nations and Inuit Health Branch, Yukon Government Department of Education, and the Health and Wellness fund through the

Government of the Northwest Territories) supported six interventions (18%). Finally, one intervention (3%) was supported by the operational budget of the local school board.

Evaluation

Fourteen interventions (41%) performed evaluations to understand the feasibility of interventions, the barriers and enablers of their implementation, and/or their impact and outcome on student knowledge, behavior, and health. For example, the Sandy Lake Health and Diabetes Project (SLHDP) in Ontario completed two evaluations to determine changes in students' knowledge, skills, and self-efficacy and behaviors related to diet by collecting anthropometric data and having students complete a questionnaires and dietary recalls (14,64).

Discussion

This scoping review provides an overview of school-based nutrition interventions for Indigenous children that have been implemented in Canada as well as a discussion of the components of identified interventions. Most of the interventions found in this review were for First Nations children, as few nutrition interventions were found for Inuit and Métis populations through the search strategy. In addition, most interventions were implemented in Western Canada, and few were found in the Territories. Other reviews have also noted the under-representation of Inuit and Métis within the scientific intervention literature (25,27), which inadequately reflects the demographic composition of Indigenous peoples in Canada and most likely the range of school nutrition interventions being implemented in Indigenous communities. This finding highlights the need for more evaluation and active knowledge dissemination concerning interventions implemented in Inuit and Métis populations in Canada to build the evidence base concerning the diversity of Indigenous nutrition interventions. Although most of the interventions identified in this review targeted First Nations populations, they nonetheless provide insight into the current status of school-based nutrition interventions in Canada.

According to the CSH framework, school-based nutrition interventions should include components that promote health and improve access to healthy foods through social and physical environments, teaching and learning, school policy, and partnerships and services (23,31). All of these components must be implemented for an intervention to be considered fully comprehensive and to have the most potential to create sustainable changes in the eating habits of children. In addition, school-based nutrition interventions for Indigenous children should include cultural content, community control and ownership, funding, and evaluation to ensure relevancy and sustainability. This review indicates that a minority of school-based nutrition interventions in Indigenous communities are comprehensive, as few included each of the four aspects of CSH and/or the four additional components identified as important in school-based nutrition interventions for Indigenous children.

All but one of the interventions included components related to the social and physical environment, which indicates that this component is important and relevant in Indigenous settings. Interventions targeted the social environment through community feasts, cooking classes, and peer-mentoring, which encouraged both healthy relationships and promoted healthy eating. With respect to the physical environment, the majority of schools offered food programs that supplemented children's diets with healthy foods. This finding supports previous research demonstrating that most band-operated First Nations schools offer food programs for students (12). Food programs may be especially important in Indigenous communities which face significant barriers related to healthy eating and child food insecurity (11). Although most schools provided breakfast, lunch, and/or snacks, the absence of food programs in one-quarter of interventions may reflect the barriers to initiating and sustaining these initiatives in schools for Indigenous children, which include challenges with acquiring adequate infrastructure funding and accessing quality and affordable healthy foods (11,12). Comprehensive school-based nutrition interventions for Indigenous children should include a social and physical environment component to provide an environment conducive to healthy eating. However, schools require the resources, facilities, and funding to support such programs.

While the teaching and learning component was incorporated in most interventions, this remains an area for improvement in current and future school-based nutrition interventions for Indigenous children. Teaching and learning is an essential component, as the incorporation of healthy eating skills and knowledge in the classroom and involvement of teachers in

promoting nutrition may serve to reinforce other components of nutrition interventions (95). Land-based learning (e.g., collecting, preparing and eating traditional food) has been recognized for its decolonizing role in revitalizing traditional food system knowledge and increasing access to healthy foods (5,96). Although some interventions included curriculum that allowed children to experience and understand traditional Indigenous subsistence practices such as hunting, fishing, and gathering, this review indicates that the incorporation of land-based learning in schools was seldom reported. The review also reveals a lack of adequate professional development opportunities and ongoing support related to teaching nutrition. In order to improve this component, teachers need the time and educational and professional resources to develop and integrate specialized nutrition education into the classroom (41).

The partnerships and services component of CSH was included in approximately two-thirds of interventions. Parent and community engagement is key in the successful implementation of school-based interventions, as it increases the potential for nutrition-related activities at school to be supported at home and for the larger community to support the nutrition needs of children (53). Thus, interventions benefit from including strategies that establish relationships with parents and the broader community. Elder involvement in interventions is also significant in schools that educate Indigenous children, as they are respected role models for younger generations and their involvement in nutrition education and the promotion of healthy eating can help ensure relevance and long-term sustainability of interventions (97).

Of the four components of CSH, policy was implemented by the fewest number of interventions. Written school nutrition policies are an integral component of CSH interventions, as they establish formal standards for all nutrition-related aspects of the school environment and coordinate other aspects of the CSH intervention (e.g., foods available, lessons included in classroom education, and strategies for community and family involvement) (98). The most comprehensive and effective policies are written in clear language and consider all aspects of a school nutrition environment to create a standard against which to hold the school community accountable for nutrition-related changes (98,99). With the exception of KSDPP, the policies identified and described in this review provided limited guidance and were focused mainly on describing the types of food that were allowed, or not allowed, in the school environment. As such, this is an area requiring particular attention by schools when developing comprehensive nutrition interventions.

In addition to the four recognized components of CSH, this review paid attention to four supplementary components (cultural content, Indigenous control and ownership, funding source, and evaluation) that should be considered when developing school-based nutrition interventions for Indigenous children (25–27,32). Given the considerable diversity that exists among Indigenous communities in Canada, interventions need to be tailored to local contexts by including specific cultural content such as traditional foods and Indigenous ways of learning (97). As just over half of interventions described one or more cultural component, this indicates an area that may require more attention when developing school-based nutrition interventions. However, it is likely that interventions were also inevitably missed in the searches due to the heterogenous nature of Indigenous peoples, the diverse settings that Indigenous children are educated in Canada, and the limited number of interventions described in the scientific literature. As such, the lack of cultural components found in this review may also be related to an under-reporting of local interventions and description of their components in the scientific and grey literature.

Community control and ownership has also been recognized as an essential component of health interventions in Indigenous communities that can assist in ensuring that interventions are relevant to local contexts (27,32). Community control and ownership helps to ensure that interventions are adapted to the unique needs of individual communities, and there is evidence that this component results in more effective and sustainable interventions (27,97). In this review, nearly two thirds of interventions mentioned community involvement in the development, implementation, and/or evaluation of school-based nutrition interventions. Participatory research methods were used in many interventions, highlighting the shift from expert driven to community driven and engaged approaches to intervention research that rely heavily on relational and equitable ways of working in partnership (100). The four interventions that included four CSH and four supplementary components used participatory methods of research that involved equitable collaboration between Indigenous community members and university researchers. This indicates that collaborative relationships between community members and researchers may

further assist in creating and sustaining comprehensive school-based nutrition interventions by increasing intervention relevance, support, and resources.

Funding is also an important consideration when developing comprehensive school-based nutrition interventions as it takes extensive resources to implement and sustain multiple intervention components. Over half of the interventions mentioned funding from a diverse range of sources. Other research has similarly shown that school interventions in Indigenous communities are funded by a myriad of donors, and lack of funding has been identified as the main barrier to implementing nutrition interventions (12). Indigenous education systems –

especially those in rural and remote areas – experience chronic underfunding and face numerous environmental barriers (e.g., facility and equipment limitations) that may affect their ability to deliver comprehensive school-based nutrition interventions (61). This review further indicates a gap in the literature related to disclosure of sources of funding and resources to support the obtainment of ongoing intervention funding. To support the development of comprehensive nutrition interventions, schools need access to information and resources about funding opportunities.

Finally, evaluation has been identified as an important component of interventions to demonstrate effectiveness and support the sustainability of programs and policies. Fewer than half of the interventions in this review reported an evaluation component, which identifies an important gap in the information currently available for school-based nutrition interventions for Indigenous children. The lack of evaluation of interventions limits the transferability of knowledge concerning their key components, and marginalizes Indigenous communities from the evidence regarding effective comprehensive school-based nutrition interventions (30,102). Without the support of researchers or other professionals, school staff may lack the time, financial resources, or capacity to perform evaluations and transfer knowledge of their interventions beyond the community level. Overall, findings suggest that interventions are under-evaluated and that schools may need support in integrating evaluation into interventions and sharing knowledge of effective (and ineffective) intervention components in the scientific and/or grey literature.

Limitations

To minimize the risk of omitting relevant sources of evidence, this review included both scientific and grey literature. Although the inclusion of grey literature expanded our range of interventions, our descriptions of these interventions was nonetheless limited to the information as provided in sources of evidence. As such, it is possible that interventions had additional components that were not identified. A more robust review would necessitate identifying, contacting, and consulting all schools attended by Indigenous children to include all nutrition interventions and their components. A review of this nature would require considerable time and resources and was not possible in this case. Finally, although the review identified interventions that had been implemented, it did not include information on how well the interventions were implemented in practice. For example, an evaluation of KDSPP found that teachers implemented the curriculum and enforced the school nutrition policy to varying degrees (75). Similarly, the Fort Albany Comprehensive School nutrition program encountered challenges associated with the remoteness of the school, which often necessitated healthy foods to be replaced with less healthy alternatives (e.g., apple juice in place of apples) (11).

Conclusions

The findings of this review provide recommendations for the necessary components that should be considered when developing comprehensive school-based nutrition interventions in Indigenous communities and highlights gaps that currently exist in intervention knowledge and practice. Although many current interventions provide supportive social and physical environmental elements, the review suggests that interventions can be more comprehensive by incorporating culturally-relevant nutrition education and professional development opportunities for teachers, written school nutrition policies to guide nutrition activities and environments, and activities that engage families and community members. Culturally-relevant and sustainable interventions must also be controlled and owned by Indigenous communities and include culturally-specific traditional foods and ways of learning. Finally, there is a need to increase intervention evaluation and the sharing of knowledge

and resources related to funding. These recommendations may be used by communities, as well as by researchers and professionals working with communities, in developing comprehensive school-based nutrition interventions to improve the eating behaviors of Indigenous children.

List Of Abbreviations

AYMP: Aboriginal Youth Mentorship Program

CSH: Comprehensive School Health

KSDPP: Kahnawake Schools Diabetes Prevention Project

MeSH: Medical Subject Headings

PRISMA-ScR: Systematic Reviews and Meta-Analyses Extension for Scoping Reviews

SLHDP: Sandy Lake Health and Diabetes Project

ZAPTD: Zhiiwapenewin Akino'maagewin: Teaching to Prevent Diabetes

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable.

Availability of data and materials

The datasets supporting the conclusions of this article are included within the article (and its additional files).

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

CG contributed to concept formation and design and was responsible for the grey literature search, selecting sources of evidence, charting and synthesizing the sources of evidence, and writing of the manuscript. JT and LH designed and performed the electronic database searches, identified MeSH terms, and exported database articles for synthesis. RB contributed to the design, selecting sources of evidence, and manuscript edits. RG and AF contributed to the design and manuscript edits. NDW was the supervisory author and was involved with design, selecting sources of evidence, and manuscript edits. All authors read and approved the final manuscript.

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Not applicable.

Additional files

File name: Additional File 1

Format: .docx

Title: MEDLINE search strategy

Description: Full electronic search strategy for MEDLINE database

File name: Additional File 2

Format: .docx

Title: Web search strategy

Description: Full grey literature search strategy

File name: Additional File 3

Format: .xlsx

Title: Extraction grid

Description: Full extraction grid

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