Public Health Nutrition: 24(9), 2650–2668 doi:10.1017/S1368980020002402

Review Article

Drivers and health implications of the dietary transition among Inuit in the Canadian Arctic: a scoping review

Matthew Little[1,2,*], Hilary Hagar[1], Chloe Zivot[1], Warren Dodd[3], Kelly Skinner[3], Tiff-Annie Kenny[4], Amy Caughey[1], Josephine Gaupholm[1] and Melanie Lemire[4,5]

[1]Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, ON, Canada: [2]School of Public Health and Social Policy, University of Victoria, Victoria, BC, Canada: [3]School of Public Health and Health Systems, University of Waterloo, Waterloo, ON, Canada: [4]Département de médecine sociale et préventive, Université Laval, Québec, QC, Canada: [5]Axe santé des populations et pratiques optimales en santé, Centre de recherche du CHU de Québec, Université Laval, Québec, QC, Canada

Submitted 10 May 2019: Final revision received 4 June 2020: Accepted 15 June 2020: First published online 11 September 2020

Abstract

Objective: The current study undertook a systematic scoping review on the drivers and implications of dietary changes among Inuit in the Canadian Arctic.

Design: A keyword search of peer-reviewed articles was performed using PubMed, Web of Science, CINAHL, Academic Search Premier, Circumpolar Health Bibliographic Database and High North Research Documents. Eligibility criteria included all full-text articles of any design reporting on research on food consumption, nutrient intake, dietary adequacy, dietary change, food security, nutrition-related chronic diseases or traditional food harvesting and consumption among Inuit populations residing in Canada. Articles reporting on *in vivo* and *in vitro* experiments or on health impacts of environmental contaminants were excluded.

Results: A total of 162 studies were included. Studies indicated declining country food (CF) consumption in favour of market food (MF). Drivers of this transition include colonial processes, poverty and socio-economic factors, changing food preferences and knowledge, and climate change. Health implications of the dietary transition are complex. Micro-nutrient deficiencies and dietary inadequacy are serious concerns and likely exacerbated by increased consumption of non-nutrient dense MF. Food insecurity, overweight, obesity and related cardiometabolic health outcomes are growing public health concerns. Meanwhile, declining CF consumption is entangled with shifting culture and traditional knowledge, with potential implications for psychological, spiritual, social and cultural health and well-being.

Conclusions: By exploring and synthesising published literature, this review provides insight into the complex factors influencing Inuit diet and health. Findings may be informative for future research, decision-making and intersectoral actions around risk assessment, food policy and innovative community programmes.

Keywords
Nutrition transition
Indigenous health
Inuit health
Food security
Food environments

Inuit are Indigenous people residing primarily in Inuit Nunangat (homelands) in the Canadian Arctic. Diets of Inuit comprise a diverse range of traditional foods (typically called country foods (CF)), including marine and land mammals, fish, shellfish, birds, and local plants and berries[1]. In the past several decades, however, Inuit have undergone a rapid dietary transition, characterised by a reduction of CF and rising consumption of a variety of market foods (MF), including an increasing amount of energy-dense and nutrient-poor products (also called non-nutrient dense foods (NNDF))[2]. This trend has translated into shifting intake patterns of various micro- and macronutrients, with wide-ranging potential implications for Inuit health[3–5]. Indeed, the ongoing dietary transition has been paralleled by rising obesity and associated non-communicable diseases (e.g. cardiovascular disease, high cholesterol, high blood pressure and type 2 diabetes)[6]. In the past decade, there has been growing research

*Corresponding author: Email matthewlittle@uvic.ca

interest in this topic, with several overlapping studies examining the environmental, social and cultural determinants of the dietary transition and implications for food security and nutrition. Additionally, many studies have examined the continued importance of CF harvesting, preparation, sharing and consumption for food security and the cultural, spiritual, mental and physical health of Inuit[7,8]. Finally, there exists a separate body of literature on the detrimental health impacts of exposure to environmental contaminants found in CF and weighing such concerns against the benefits of CF consumption[9]. As of yet, there has been little effort to synthesise these disparate literatures and assess the drivers and wide-ranging health implications of the nutrition transition.

Considering this, a comprehensive and systematic literature review is needed to understand key patterns and identify gaps in the published literature on the complex interactions between environmental, social, economic, cultural and political factors and nutritional intake and health. This scoping review therefore aims to characterise the nature, range and extent of published research discussing the drivers and implications of the dietary transition in Inuit populations residing in Inuit Nunangat. By exploring and synthesising published literature, this review provides insight into the complex challenges influencing nutritional health among Inuit, which can inform research, decision-making and action on risk assessment, food policy and community food programmes.

Methods

Due to the complex and multidisciplinary nature of the literature on food, nutrition and nutrition-related health outcomes in the Canadian Arctic, we selected a scoping review approach, which is particularly suited to identify, examine and characterise the extent, nature and findings of research across diverse disciplines. Scoping reviews are particularly appropriate for mapping out research activities on a broad topic and are often used to compile and summarise emerging areas of research and to determine gaps in an existing body of knowledge[10]. This scoping review was guided by the work of Arksey and O'Malley[11], Dijkers[12] and Levac and colleagues[10]. Methods and findings were reported according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews checklist[13]. The review protocol is available upon request.

Study selection

We conducted a literature search using PubMed, Web of Science (Web of Knowledge), CINAHL with Full Text (EBSCO), Academic Search Premier (EBSCO), Circumpolar Health Bibliographic Database and High North Research Documents. The search covered articles published up to 21 September 2019, limited to English language and available in an electronic format. Searches employed both controlled vocabularies, such as Medical Subject Headings, and keywords. The search strategy comprised three groups of search terms: geographic area or population (Canadian Arctic, Northern Canada, Inuit, Eskimo, Inuvialuit Settlement Region (ISR), Nunavut, Nunavik, Nunatsiavut and NunatuKavut), food consumption qualifiers (food, diet, nutrition, nutrient, hunt, harvest and contaminant) and health qualifiers (health, disease, infection, syndrome, wellness, well-being and malnutrition). No limiters were used, and search strategies were adapted for each database. A Science Citation Index (Web of Science) search strategy is presented in Box 1.

Box 1: Example search strategy to identify studies on the impacts of dietary change on nutrient intake and contaminant exposure in Canadian Arctic Inuit communities using Web of Science

TS = (("Canadian Arctic" OR Inuit OR Eskim* OR "Northern Canada" OR Inuvialuit OR Nunavut OR Nunavik OR Nunatsiavut OR NunatuKavut)

AND TS = (Food* OR Diet* OR Contaminant* OR Nutrition* OR Nutrient* OR Hunt* OR Harvest*)

AND TS = (Health* OR Disease * OR Infect* OR Syndrome* OR Wellness OR Wellbeing OR Malnutrition)

Note: Eskim* captures references to Eskimo and Eskimeaux and is included as a search term to capture historical literature published over the last decades, although these terms are not considered acceptable by Inuit or contemporary academic communities.

Inclusion criteria

Population-based studies, reviews and reports of any design (including qualitative studies, prospective cohort studies, cross-sectional studies, intervention trials and systematic literature reviews) were included if they provided information relevant to food consumption, nutrient intake, dietary adequacy, dietary change, food security, nutrition-related chronic diseases or CF harvesting and consumption among Inuit populations residing in Inuit Nunangat. Inuit Nunangat refers to the homeland region of Inuit in present-day Canada, including ISR (Northwest Territories), Nunavut, Nunavik (northern Quebec), Nunatsiavut (northern Labrador) and NunatuKavut (southern Labrador)[14].

Exclusion criteria

Articles that were unavailable in full text were excluded. Studies focusing on *in vitro* or *in vivo* experiments were excluded. Additionally, studies that primarily reported on health impacts of contaminant exposure or zoonoses from

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

CF sources were excluded, due to a number of recent reviews on this subject[9,15–18].

Screening process

Two independent reviewers (M.L. and H.H.) conducted the first screening stage, during which titles, abstracts and keywords of each article were screened for relevance using an eligibility form. The Kappa score for this stage was 0·81, indicating a strong level of agreement between reviewers[19]. Articles meeting the screening criteria proceeded to a second stage of screening, which entailed a full-text review conducted by two reviewers using a detailed screening form. The Kappa score for the full-text screening stage was 0·92, indicating an almost perfect level of agreement between reviewers[19]. Reviewers met throughout the screening process to resolve conflicts. For all included articles, reference lists were hand-searched for relevant titles that were not captured in the initial search. Relevant full-text articles proceeded to data extraction and analysis.

Data extraction and synthesis

Data were extracted by the two reviewers working independently. Any disagreements were resolved by consensus; if consensus was not reached, a third reviewer also conducted data extraction. The Kappa score for data extraction could not be calculated because both descriptive and qualitative (text) data were extracted from each article. Descriptive data items were extracted in DistillerSR (Evidence Partners), using a charting form designed for the purpose. Descriptive characteristics included study year, region of study, study design, analytical techniques, type of participants, sample size, exposures and outcomes assessed (if applicable), relevant measures of frequency (e.g. prevalence, incidence, dietary intake, if applicable) and associations (e.g. odds ratios and incidence rate ratios, if applicable). Following this, data were imported into Microsoft Excel (Microsoft Corporation) for analysis.

A thematic analysis was conducted on each full-text article using NVivo version 12.0 (QSR International), qualitative data analysis software. Thematic analysis is a method for identifying, analysing and reporting 'themes' in data[20] and is often used in qualitative data sets; however, its usefulness for conducting systematic literature reviews and scoping reviews has recently been recognised[10]. We employed an inductive thematic analysis to derive initial codes (basic elements or segments of information) from each full-text article[21], then merged codes into themes in an iterative process that identified and separated themes based on similarities, differences and depth of supporting data. Finally, we reviewed, defined, named and reported on themes[20].

Results

Characteristics of included articles

The search strategy identified 3301 articles and 1824 articles after deduplication. A total of 162 peer-reviewed articles, government publications and organisational reports met all the inclusion and exclusion criteria and were included in the literature review (Fig. 1). Articles are presented by year in Fig. 2; of the 162 articles, the largest proportion was published in 2010, with a decreasing trend in recent years. Research conducted in multiple regions of Inuit Nunangat was most common (30 %), followed by Nunavik (25 %), Nunavut (28 %) and ISR (10 %) (Fig. 3). Cross-sectional epidemiological studies (73 %) and qualitative studies (10 %) comprised the majority of the articles, followed by literature reviews (e.g. systematic reviews and scoping reviews) (6 %) and studies on interventions (e.g. community-based food programmes and policies) (4 %) (Fig. 4).

Themes identified in the literature

Articles were grouped broadly by primary topic (Fig. 5). A large proportion (65 %) of articles described dietary intake and adequacy and assessed nutrition-related health outcomes and biomarkers. Lesser proportions of articles examined food security (11 %), food-related programmes and policies (9 %), impacts of climate change on food access (4 %) and risk-benefit trade-offs of CF and MF consumption (4 %). Notably, while many articles mentioned the socio-cultural importance and implications of CF consumption, few articles examined this as a primary topic (5 %). Few articles examined food environments and determinants of dietary choices (2 %). Many articles used data from the same studies, the most common of which are presented in Table 1. Several themes were identified in the thematic analysis and will be described in detail in the following sections.

Description of dietary trends

Prior to colonial contact, the diets of Inuit consisted entirely of CF acquired from land-based harvesting. Dietary staples included land mammals (e.g. caribou, muskox and polar bear), marine mammals (e.g. seal, whale and walrus), fish (e.g. Arctic char, brook trout, lake whitefish and lake trout), shellfish (e.g. mussels, clams and oysters), wildfowl (geese, ptarmigan, marine birds and eggs) and plant-based foods (e.g. seaweed and berries)[1,5,29]. Overall, while longitudinal data are sparse, the literature suggests that CF consumption has declined rapidly in the last several decades (Table S1), in many cases replaced by purchased NNDF (defined as high-fat and/or high-sugar foods). Published data do not precede 1969, but surveys from the late 1960s and 1970s suggest that CF comprised approximately half of all consumed foods during those decades[35–37]. As recently as 1987, CF still provided between up to one-half (46·5 %) of the total energy intake (TEI: measured as energies consumed) of Inuit in Qikiqtarjuaq (Nunavut), depending on the age group[38–40]. Successive surveys in ISR, Nunavut and Nunavik have found that TEI contributions from CF declined from 21 to 28 % in the 1990s to

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

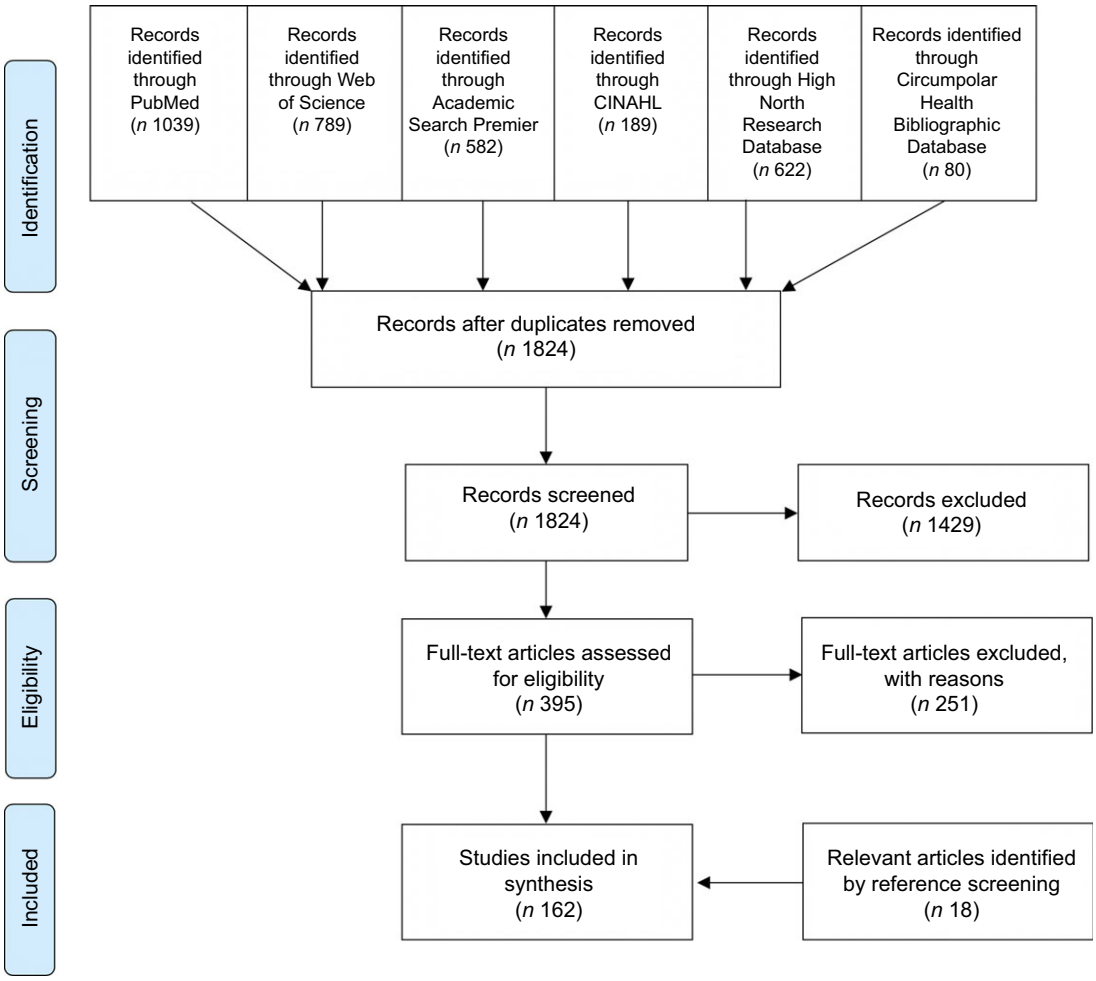

Fig. 1 (colour online) Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting flow diagram showing four-stage article selection process used to identify articles on drivers and health implications of the dietary transition among Inuit in the Canadian Arctic

between 14 and 16 % in studies conducted between 2004 and 2008[3,25,41–44]. In Nunatsiavut, while historical data are sparse, a study conducted in 2014–2015 in three communities suggested that CF comprised, on average, only 2 % of TEI[45].

Conversely, the percentage of energy intake from MF, including NNDF, has increased steadily. Currently, NNDF are consumed much more frequently than CF, contributing between 25 and 51 % of TEI, depending on region and age group[35,38,39,41–50]. Meanwhile, consumption of nutrient-dense MF (e.g. fruits and vegetables) is reported to be low[41,49,51,52]. Of particular concern is the increased popularity of foods high in simple carbohydrates. Indeed, the percentage of energy intake from sweetened beverages (e.g. carbonated and powdered drinks, coffee and tea with added sugar) and high-carbohydrate foods (e.g. bread, pasta and bannock) increased substantially between the late 1980s and 2008 and now contributes over 20 % of TEI, on average[25,38,40,43,44,46–50]. In 2007–2008, the International Polar Year (IPY) Inuit Health Survey reported that the top ten contributors to TEI were mostly NNDF, including candy, processed meats, chips, white bread and pizza[38].

Reviewed literature reported that dietary patterns differed according to demographic factors. Women reported consuming less CF than men across all age groups in all Arctic regions, dating back to surveys in the 1980s[25,40]. Irrespective of gender, CF intake increased with age across all dietary studies[5,24,35,36,53] and youth and young adults consistently consumed fewer CF and more MF than their parents[2,5,23–25,40,41,54]. Recently, the IPY Inuit Health Survey found that adults aged 41–60 years consumed almost double the proportion of CF compared to younger adults[55]. Several studies reported that households with children consumed more MF than households without children[27,56,57]. However, households with children also consumed more fruits and vegetables[27,56,57], perhaps partially offsetting nutrients lost from low consumption of CF. Studies conducted in Nunavut and Nunavik indicated that participation in traditional activities, such as hunting, increases from youth to adulthood, with potential impacts

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

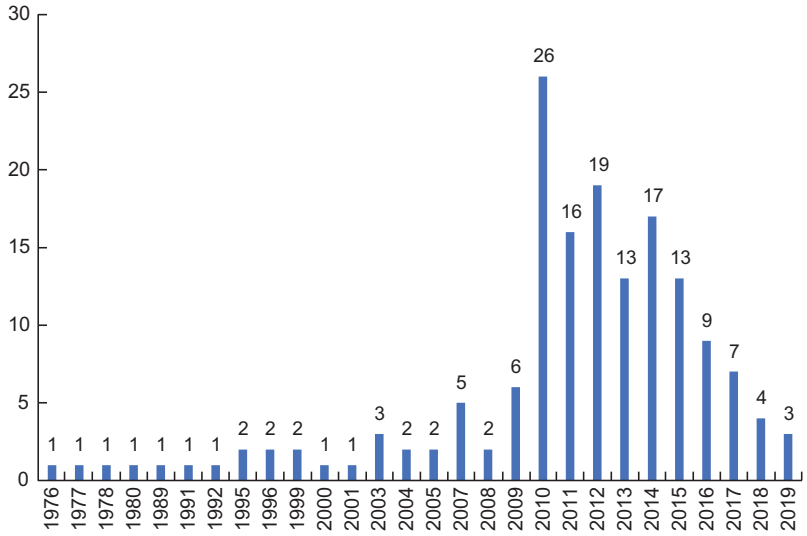

Fig. 2 (colour online) Number of relevant articles discussing drivers and implications of the dietary transition in the Canadian Arctic by year of publication (*n* 162)

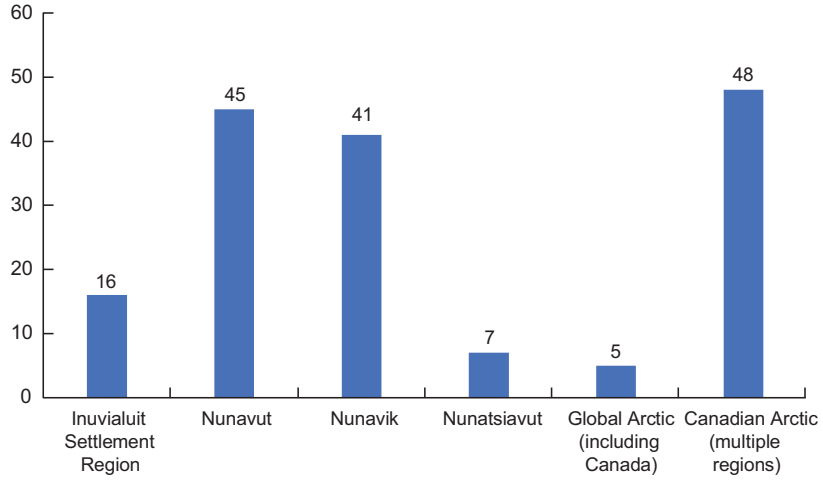

Fig. 3 (colour online) Number of articles by region on drivers and health implications of the dietary transition among Inuit in the Canadian Arctic (*n* 162)

on CF access and consumption[58]. A paucity of longitudinal data limits our ability to determine whether and how much CF intake changes as one ages. It is likely that dietary changes occur across generations as well as over the life course of individuals, creating challenges to interpreting overall time trends in average intake of CF and MF[24].

Determinants of dietary transitions, dietary intake and food security

Articles described a number of complex mechanisms and processes that have affected dietary patterns among Inuit and driven the transition from CF to MF[59,60]. Colonial economic and political factors, cultural food preferences, harvesting practices and climate change have interacted to drive dietary changes across Inuit Nunangat.

Historical, colonial and economic factors. Historical and ongoing colonial processes have had wide-ranging impacts on Inuit sovereignty, cultural practices and social structures, impacting food access and consumption in a number of ways[65]. Several authors emphasised the integral importance of harvesting, sharing and consuming CF to Inuit traditions, culture, identity, health and well-being[7,8,22,61–65]. Qualitative studies have documented the importance of CF in connecting Inuit with surrounding lands, community and family[7,61]. Changes to household and social structures following the establishment and growth of Inuit communities have contributed to disruptions in CF sharing networks, resulting in reductions in some food sharing practices[66,67]. Schooling and employment have restricted the time available for collecting food from the land[66–70]. Meanwhile, wildlife management structures have established and enforced harvest restrictions and harvest bans on certain animal populations (e.g. beluga and caribou), thereby

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

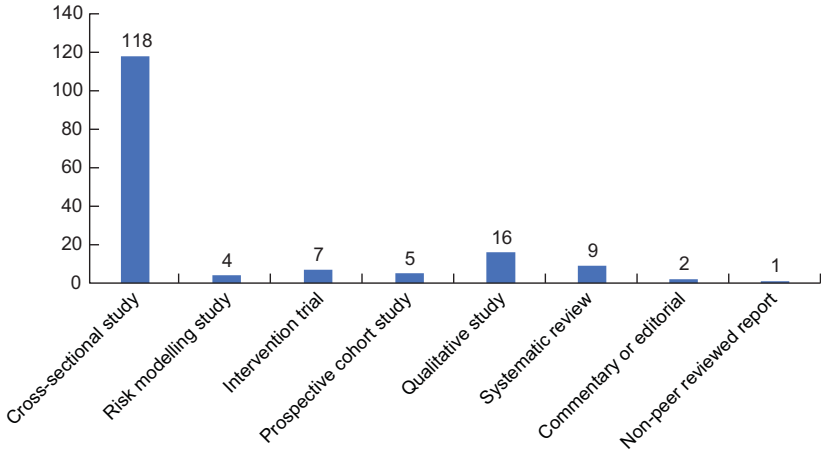

Fig. 4 (colour online) Number of articles by study type on drivers and health implications of the dietary transition among Inuit in the Canadian Arctic (*n* 162)

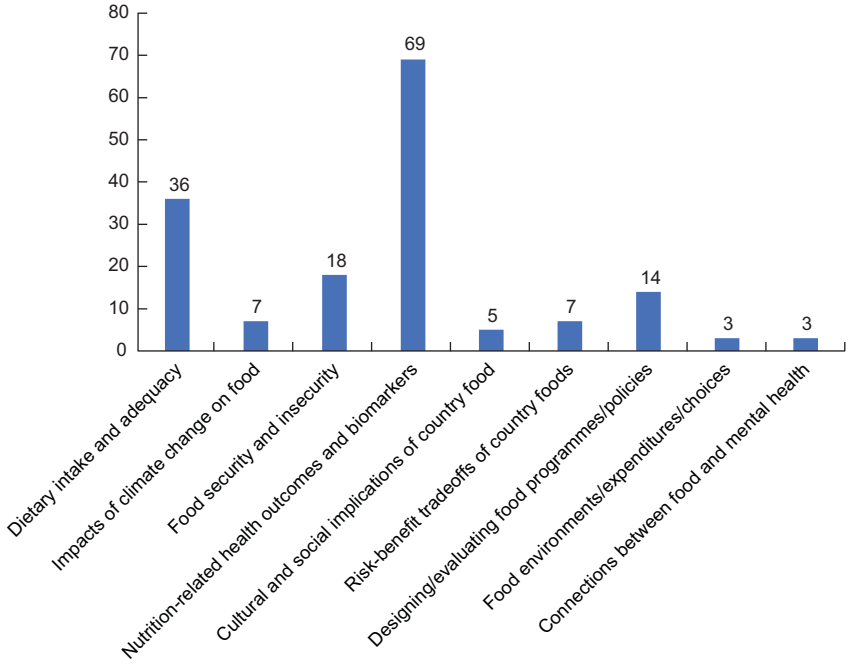

Fig. 5 (colour online) Number of articles by topic included in scoping review on drivers and health implications of the dietary transition among Inuit in the Canadian Arctic

limiting their accessibility for Inuit hunters[60,68,71–73]. Some authors identified and discussed the cyclical nature of knowledge loss, in which reductions in hunting, preparing and consuming CF limit the intergenerational transfer of traditional knowledge, causing further reductions in CF consumption[65,67,73]. Elders in northern communities have expressed particular concern that youth are spending less time conducting subsistence activities, thus poorly equipping them to participate in CF harvest and preparation[7,68,73].

Over time, transport infrastructure and retail stores have provided increased availability of MF. In addition, MF have become increasingly acceptable and desirable as a result of advertising and social exchange with non-Indigenous people[60]. Meanwhile, CF have not yet been consistently integrated into the market economy in most regions, perhaps due to the cultural incongruity of exchanging money for foods that were traditionally shared[61,74]. When CF are available for purchase (often through the online informal economy), they tend to be costly[61,74]. Moreover, nutrient-dense MF (e.g. fresh vegetables and fruit) are often unavailable, expensive or poor quality in remote Arctic communities due to logistical challenges (e.g. weather disruptions) and extreme temperatures during transport[75]. In many communities, limited competition among food retailers has been reported to

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

Table 1. Identification and characteristics of major studies conducted with Inuit populations in the Canadian Arctic since 1987

Study name	Year	Study location(s)	Sample size	Sample population	Key references
Broughton Island Dietary Survey	1987–1988	Qikiqtarjuaq, Nunavut	366	Entire hamlet	Kuhnlein *et al.*[22]
Santé Quebec Health Survey	1992	14 communities in Nunavik (Northern Québec)	492	Adults aged 18 years and older	Dewailly *et al.*[23]; Blanchet *et al.*[24]
Centre for Indigenous Peoples' Nutrition and Environment (CINE) Study	1999	18 communities in five regions (Inuvialuit Settlement Region; Nunavut's Kitikmeot, Kivaliq, and Qikiqtaaluk [Baffin] regions; and Labrador)	1929	Adolescents and adults aged 16 years and older	Sheikh *et al.*[25]
Aboriginal Peoples' Survey	2001	53 Inuit communities across four regions (Inuvialuit Settlement Region, Nunavut, Nunavik, and Nunatsiavut)	26 290	Adults aged 18 years and older	Richmond *et al.*[26]
Qanuippitaa? (How are we?)	2004	14 Inuit communities in Nunavik (Northern Quebec)	889 total: 778 completed FFQ; 644 completed 24-h dietary recalls	Adults aged 18 years and older	Blanchet & Rochette[3]
Nunavut Inuit Child Health Survey	2007–2008	16 communities in Nunavut	388	3–5 years	Egeland *et al.*[27]; Pacey *et al.*[28]
International Polar Year (IPY) Inuit Human Health Survey	2007–2008	36 Inuit communities (33 coastal and 3 non-coastal) in Inuvialuit Settlement Region, Nunavut Territory and Nunatsiavut Region	2595	Adults aged 18 years or older	Sheikh *et al.*[25]
Health Foods North Baseline Study	2007–2008	3 communities in Inuvialuit Settlement Region; 3 communities in Nunavut	235 and 211 in Inuvialuit Settlement Region and Nunavut, respectively	Adults (including non-pregnant women) aged 19 years and older	Sharma[29]; Mead *et al.*[30]
Healthy Foods North Follow-Up Study	2009	3 communities in Inuvialuit Settlement Region; 3 communities in Nunavut	136	Adult women (aged 19–44 years)	Bains *et al.*[31]; Mead *et al.*[32]
Nunavik Child Development Survey	Recruited between 1994 and 2001; follow-up between 2005 and 2010	Nunavik	300 between 1994 and 2001; 294 between 2005 and 2010	Children	Dallaire *et al.*[33]
Nunavik Childcare Nutrition Program Baseline Study	2006–2010	Nunavik	245	Children (aged 11–54 months)	Gagné *et al.*[34]

further exacerbate high food prices[75]. Damaged or spoiled products past their best-before dates were commonly reported in northern stores, creating a reliance on less expensive, non-perishable processed foods that are usually non-nutrient dense[26,61,75–77].

Financial challenges and low socio-economic status were often cited as barriers to accessing CF and healthy MF. Increased dependence on modern equipment for CF harvesting (e.g. vehicles, fuel, firearms and ammunition), combined with their high cost in northern communities, creates significant challenges to harvesting CF[51,54,65,67,78–80]. Studies across the Arctic found that a number of indicators of socio-economic status (e.g. low education, unemployment, household crowding, receiving social assistance, public housing and having a home in need of major repairs) were associated with food insecurity and lower consumption of CF and fruits and vegetables[48,52,59,81–85]. Successive studies in Nunavut found that availability and affordability of foods, high cost of harvesting CF, limited budgeting skills and unfamiliarity with nutritional content of different MF were driving food choices towards NNDF[81,82,86].

Food preferences, perceptions and knowledge. Several studies reported on food preferences, perceptions and knowledge. A qualitative study conducted with Inuit living in south-east Labrador discussed the changing relationship that Inuit have with their food. This study confirms that individuals have had to rapidly adapt from a food environment replete with locally harvested CF to one with many food choices, including newer MF. As argued by the authors, these rapid changes in food availability limited the ability

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

of Inuit to rely on traditional nutrition and food preparation knowledge and have forced individuals to 're-learn' how and what to eat[68].

Importantly, many Inuit maintain a desire to consume CF. Several surveys conducted with Inuit reported that the majority of respondents preferred a mixture of CF and MF and expressed a desire to eat more CF than they currently consume[54,61,87]. CF were viewed as healthier than MF, and some Inuit reported feeling 'lazy', 'tired' and 'unfulfilled' when they do not eat CF[7,62,88]. MF were often perceived as being of inferior quality, being described as 'sugary', 'junk' or 'garbage'[63]. However, due to availability, convenience, affordability, advertising and palatability, food preferences may be shifting towards MF, particularly among young people. In interviews, some Inuit describe the difficulties of having children who only crave junk food, and how this was often the least expensive option to feed them[7,61]. Risk perception was an important challenge; semi-structured interviews with Inuit adults in Nunavik revealed that 33 % of individuals were worried about environmental contaminants in CF and intentionally limited their consumption of foods they viewed as 'high-risk'[65].

As Inuit transition from CF to MF, a number of factors may act as barriers to the acceptability of nutrient-dense MF (e.g. fruits and vegetables) and drive food choices towards NNDF. The introduction of improved means of communication (television and, more recently, internet) has increased exposure to food marketing, likely contributing to shifting food preferences, particularly among young people[61]. An ethnographic study conducted in Iqaluit, Nunavut suggested that easy-to-eat products such as store-bought snack foods may be popular since they align with the traditional practices of food sharing, eating 'on-the-go' while hunting or fishing, and eating when one is hungry instead of structured meals[89,90]. Household crowding and financial insecurity may also influence food purchasing and eating behaviours by forcing families to make more frequent, smaller grocery purchases[90]. Further, limited culinary knowledge of preparation methods for perishable MF may reduce their acceptability among Inuit households and encourage consumption of more convenient non-nutrient dense MF dishes[84].

Climate change. Dietary changes have been exacerbated by climate change, which has disrupted CF harvest practices by altering migration patterns of animals (birds, land mammals and marine mammals), intensifying animal population declines[71] and reducing the predictability of weather and travel conditions, thus impacting the navigability of traditional hunting grounds (e.g. by altering water levels, snow pack and sea ice)[54,63,70,73,79,81,82,91–95]. In Nunavut, hunters have reported lower water levels in ponds and rivers along the coastline, resulting in reduced access to fish and birds[93]. Snowfall has become more variable, driving a shift in migration patterns of caribou across Inuit Nunangat[63,93]. Availability of berries was reported to have declined across the Arctic due to changing weather patterns and invasive plant species[63,93]. Inuit have described reductions in sea ice extent, thickness, quality and duration, limiting access to traditional hunting areas and increasing the danger and difficulty associated with harvesting marine CF[63,81,82,93]. Other climate-induced changes reported by hunters include 'paler' flesh in Arctic char (possibly indicative of a changing diet), less fat on ringed seals (resulting in less buoyancy and a higher proportion of lost seals) and increased parasites in caribou meat[93]. Changes in predator-prey balance have also been reported by hunters; for example, increased killer whale (orca), polar bear, narwhal and bowhead whale populations in Repulse Bay have reportedly driven beluga populations away from the community[93]. Climate change has also affected CF safety. In Nunatsiavut, Inuit residents have reported that the sun's heat has intensified in recent years, at times spoiling meat during harvest and increasing the risk of parasites, pathogens and toxins (e.g. botulinum toxin) in CF preparations[63,93,96]. Collectively, these climate-induced phenomena challenge skilled harvesters and reduce their capacity to harvest, share and prepare CF[59,63,95].

Possible impacts of the dietary transition on health outcomes

Despite declining intake, it is important to note that CF remain a very important source of energy and nutrients and often contribute up to half of overall protein and Fe and over 70 % of overall *n*-3 polyunsaturated fatty acid (PUFA) intake[4,42,45,60,71,97]. Indeed, individuals that regularly consume CF have significantly higher intakes of energy, percentage of energy from protein and protein-related micronutrients, fibre, Ca, *n*-3 PUFA, riboflavin, niacin, Fe, Zn, Cu, Mg, K, selenium (Se), vitamins A, B_6, B_{12}, C, D and E and a lower intake of carbohydrates, saturated fat and Na[4,5,23,29,40,45,53,55,60,69,98–100].

However, the dietary transition from primarily CF to primarily MF (including a large proportion of NNDF) has implications for nutrient intakes, food security and health (including nutritional, cardiometabolic, oral, socio-cultural and psychological health). No studies conducted with Inuit populations in the Canadian Arctic have directly assessed the impacts of dietary change using longitudinal data; however, successive cross-sectional studies provide insight into the shifting food security and health burdens that parallel the dietary transition.

Food insecurity and dietary adequacy. Cross-sectional studies in Inuit Nunangat employed different questionnaires and classifications of food security, leading to inconsistent figures; however, it is well recognised that Inuit disproportionately suffer from food insecurity, nutrient deficiencies and poor dietary adequacy compared with the rest of Canada. Overall, across Inuit Nunangat, 62·6 % of Inuit households are food insecure, with 27·2 % being severely food insecure[83]. Consistently high localised

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

prevalence of household food insecurity was reported in Nunavut (68·8 %), ISR (43·3 %), Nunatsiavut (45·7 %) and Nunavik (49·7 %)[57,83,101–106]. While food retail subsidy initiatives, such as Nutrition North Canada (NNC), exist to support healthy MF transport to Inuit communities, data suggest that food insecurity has increased in many regions (including Nunavut) over the past decade despite such subsidies[104].

Food insecurity and reduced CF consumption may combine to produce dietary inadequacies and nutrient deficiencies across Inuit communities[53,107–116]. Studies reporting on dietary adequacy suggested that consumption of micronutrients (e.g. Ca and folate), essential vitamins (vitamins A, C, D and E) and fibre was significantly lower than recommended levels in ISR[38] and Nunavut among adults[42] and children[108,111,112] (Table S5). Other assessments in Inuit adults confirmed that dietary fibre, Ca, folate, Mg, and K and vitamins A and E (and vitamin D among women) were below recommended intake in 50–100 % of participants, and deficiency was often associated with food insecurity[33,48,52,97,99,108–110,113–115]. Another contributing factor to poor dietary adequacy may be limited intake of fruits and vegetables, likely due to poor access, poor quality and high prices, as described above[50,52,113].

Iron deficiency and anaemia. Iron deficiency and anaemia are substantial public health concerns among Inuit, despite frequent consumption of foods high in bioavailable iron, including traditional meats[117]. Most studies have found that dietary adequacy of iron is sufficient; indeed, between 91 and 100% of Inuit consume more than the estimated average requirement of iron[55]. However, prevalence of clinical iron deficiency (based on serum ferritin) is high in Inuit communities, with figures between 20·4 and 35·6 %[98,118–120] among women and 18 and 33% among children[102,121] (Table S2). Overall prevalence estimates of anaemia were similarly high, with studies determining figures between 22 and 43 %[98,118,120] among women, 13 and 17% among children[102,121,122], and 16% among men[123,124]. Determinants of low serum ferritin, iron deficiency, depleted iron stores, low Hb and/or anaemia included infection with *H. pylori*[98,118,123], food insecurity[4,98,123], not having a hunter in the home[123,124], low frequency of sea mammal consumption[98] and decreased red blood cell PUFA status[98]. Due to the co-existence of high meat consumption with anaemia, Jamieson and Kuhnlein argued that iron deficiency anaemia likely does not constitute the majority of anaemia cases in the Arctic and that other underlying nutritional deficiencies (e.g. vitamins A, E, C, riboflavin and folate), as well as active infections, parasitosis and gastrointestinal *H. pylori* colonisation, must be considered important determinants[117].

Cardiometabolic health. Until recently, obesity and related cardiometabolic health outcomes (including type 2 diabetes (T2D), hypertension, hypercholesterolaemia and CVD) were uncommon among Inuit[140,141]. Several researchers attributed this to their elevated consumption of marine foods, which are rich in cardioprotective *n*-3 PUFA and Se[17,41,100,125–139]. Yet, obesity and related health outcomes are becoming more common, likely in part due to reduced *n*-3 PUFA consumption and increased intake of NNDF high in sodium, sugar and unhealthy fats (Table S3)[22,41,130,142,143]. Estimates from surveys conducted between 2004 and 2008 suggest that combined overweight and obesity affects between 52 and 63 % of Inuit[6,147] and is particularly prevalent among women[2,22,50,144–146]. Smaller scale studies have also reported high prevalence of childhood overweight and obesity in recent years[2,142,148,149]. Dietary determinants of at-risk body mass index (BMI), overweight and obesity included food insecurity[27,150], high-sugar drink consumption[151] and low physical activity[83,151,152]. The Nunavut Inuit Child Health Survey (2007–2008) was unable to establish a relationship between obesity and consumption of MF or food insecurity among children aged 3–5 years, suggesting that non-dietary factors may be driving childhood obesity[27,113,142].

BMI, waist:hip ratio, waist circumference and overweight/obesity were associated with a number of adverse cardiometabolic health outcomes in health surveys conducted across Inuit communities, including hypertension[153], unfavourable lipid profiles[154], metabolic syndrome[153], insulin resistance[153], fasting glycaemia[2,147], type 2 diabetes[147] and CVD[155]. However, some studies reported that obesity has fewer cardiometabolic health impacts among Inuit when compared with other Canadians. Indeed, Inuit have lower fasting glucose, triacylglyceride levels, cholesterol, blood pressure and lower prevalence of T2D for a given BMI or waist circumference when compared with Canadians of European ancestry[6,156–158]. It has been suggested that long-term adaptation to Arctic cold favours deposition of abdominal fat, thus higher BMI in Inuit may be a natural adaptive evolution to a colder environment[159]. Such hypotheses would support the establishment of different BMI, waist:hip ratio and waist circumference risk thresholds for Inuit when compared with Euro-Canadians[156,159].

Despite this, adverse cardiometabolic health outcomes have been steadily increasing in recent years to parallel rises in overweight and obesity. Successive cross-sectional studies across the Arctic have shown increasing trends in the prevalence of glucose intolerance and T2D (Table S4), although the general T2D burden remains lower than in other Indigenous populations in Canada[2,84,144,145,147,157,160–163]. However, among certain Inuit sub-populations (e.g. elderly females), age-standardised prevalence of T2D may exceed Canadian reference values[164]. Few studies reported associations between dietary intake and measures of glucose intolerance or T2D[2,163]. Singer and colleagues[2] reported that individuals who spent less time on the land had lower odds of T2D, which may be indicative of the protective effects of physical activity and diets high in CF.

Meanwhile, cardiovascular risk factors (hypertension, hypercholesteraemia and poor blood lipid profiles) are also

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

becoming more prevalent among Inuit. Subsequent cross-sectional studies conducted in Nunavik showed that hypertension doubled among adults between 1994 and 2004 from 9 to 19 %[145] and is currently above 25 % across other regions of the Arctic[160]. Hypercholesterolaemia and poor blood lipid profiles are increasingly common, likely due to a combination of (and interactions between) genetic, dietary and lifestyle traits[145,147,165–167]. Further, several CVD (stroke, cerebrovascular diseases and ischemic heart disease), once absent in Inuit populations, are now reaching burdens similar to the Canadian general population[145,164].

While measures of overweight and obesity were consistently associated with poorer cardiometabolic health, few studies examined dietary risk factors associated with hypertension, poor lipid profiles and CVD among Inuit populations[155]. Dietary sodium intake was highly correlated with blood pressure and hypertension in Nunavik[168], which may indicate that MF consumption is associated with adverse cardiometabolic outcomes. While several authors speculated that dietary factors may be responsible for increasing prevalence of CVD[89,169], only one study was able to establish associations between dietary patterns and CVD health outcomes[170]. Using principal component analysis to derive profiles of food consumption, Hu and colleagues[170] identified three dietary patterns ('market food', 'country food – fat' and 'country food – fish') and found that the 'market food' diet was associated with elevated prevalence of coronary heart disease (CHD) and myocardial infarction[170]. Meanwhile, the 'country food – fish' diet (characterised by high fish consumption and low sugar and sweets intake) was inversely associated with the prevalence of CHD, myocardial infarction, stroke and hyperlipidaemia[170].

Psychological, social and mental health outcomes. Traditional practices of harvesting, sharing and consuming CF have been linked to improved mental and social health outcomes[67,184]. Three studies indicate that higher *n*-3 PUFA status (which are abundant in marine CF) is protective against psychological distress[134,136,138]. In a study assessing individual- and community-level determinants of Inuit youth mental wellness in Nunavik, Gray and colleagues found that a strong relationship to the land, including harvesting, processing, sharing and consuming CF, was associated with better mental wellness and lower suicidal ideation[185]. At the community level, they also observed lower suicidality rates in communities where more CF were harvested, processed and shared[185]. These results aligned with another study by Fraser and colleagues, who found that participating in hunting activities was protective against suicide attempts among young Inuit women[186]. Importantly, several studies found that participation in CF harvesting, sharing and consumption built pride and confidence[56], encouraged good mental and spiritual health[7,63,91,187] and was associated with high levels of social support and stronger relationships between individuals, their families, communities and the land[7,88,184].

Community-based interventions to improve food security and nutrition. Evaluations of nutrition intervention trials and community food programmes showed that community-based initiatives can successfully improve dietary adequacy, nutrition education, and food-related self-efficacy and intentions[32,61,77,78]. For example, the Healthy Foods North nutrition intervention, implemented in six communities in Nunavut and NWT, revealed that a holistic approach composed of education workshops, media campaigns and targeted changes in the food environment (e.g. improved availability of healthy MF) positively impacted food intentions and choices and improved dietary adequacy, especially among overweight and obese participants[31,77]. A dietary intervention programme implemented in childcare centres across Nunavik was found to improve children's intakes of vegetables and fruit, grain products, and milk and alternatives, as well as several nutrients (e.g. *n*-3 PUFA, total Fe and Ca)[34]. Healthy eating policies have been implemented with some success in a school in Aklavik, NWT[188]. Meanwhile, community food programmes, such as food banks, soup kitchens and community freezers, have successfully alleviated severe food insecurity and improved access to culturally appropriate foods in many northern communities[61,78].

Discussion

The purpose of this review was to synthesise published literature on ongoing dietary changes among Inuit living in northern Canada and implications for health and well-being. Evidence from across the Canadian Arctic indicates that a dietary transition is indeed occurring, characterised by reductions of CF and increased consumption of MF, and in particular NNDF[46,55]. This transition is occurring despite widespread preferences for CF[54,61,87]. Ongoing dietary transitions are driven by the profound social, economic, cultural and environmental changes across Inuit Nunangat in the past several decades that impact all spheres of Inuit life[59]. Such changes are largely rooted in colonial processes. Demographic pressures, poverty, lack of time (due to schooling and employment), loss of traditional knowledge, improved transportation and communication networks, hunting and fishing restrictions, shifting dietary preferences, fear of environmental contaminants and climate change have all challenged access to land and local resources, reduced CF harvest and consumption, and increased intake of NNDF foods[46,59,61,71,78,187]. Dietary changes are compounded by shifting lifestyle patterns (e.g. reduced physical activity) to alter health and disease patterns among Inuit across the Arctic[43,59]. While cardiovascular and metabolic risk factors and health outcomes

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

were once absent among Inuit, successional cross-sectional studies suggest steadily increasing prevalence of overweight and obesity, impaired glucose tolerance and T2D, hypertension, hypercholesterolaemia and CVD[2,84,145–147,157,160,162,189]. In many cases, prevalence estimates of overweight and obesity, type 2 diabetes, CVD and associated risk factors among Inuit are approaching or surpassing those seen in the Canadian general population and represent serious public health concerns[145,157,164,190,191,193].

In Inuit communities, the high cost of CF harvesting activities and nutritious MF poses a significant challenge to obtaining a healthy diet. High food costs persist despite the existence of NNC, a programme that replaced the Food Mail Program in 2011. NNC is administered by Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) and is designed to lower the cost of perishable foods by providing northern retailers with a subsidy on a selected list of foods[194]. This programme has been criticised for several years due to poor reporting tools and programme responsiveness, inappropriate eligibility criteria for communities, failing to mitigate geographical inequities in the availability and affordability of food, a lack of accountability and failing to ensure that subsidies are passed to the consumer[195–197]. Despite the subsidies provided by NNC, the amount of household income spent on food in the Canadian North is considerably higher than in the rest of the country. Food Secure Canada and Qikiqtani Inuit Association have recommended developing a national food policy that embraces a food sovereignty approach for Inuit, including changes to the NNC to improve affordability and accessibility of healthy MF and increased support for CF harvesting[84,198]. While CIRNAC announced changes to the NNC programme in December 2018, including hunter support grants (to be implemented in 2020), it will be important to closely monitor the community impacts of NNC to determine if such changes ultimately benefit Inuit[199].

While CF are recognised as having nutritional, cultural and spiritual benefits, consumption of CF confers higher-than-average levels of some environmental contaminants in Inuit populations, including heavy metals (e.g. MeHg and Pb) and persistent organic pollutants (POP) (e.g. polychlorinated biphenyls, organochlorine pesticides, polybrominated diphenyl ethers, perfluoroalkyl and polyfluoroalkyl substances)[16,18]. While body burdens of many environmental contaminants (e.g. legacy POP such as polychlorinated biphenyls, organochlorine pesticides, polybrominated diphenyl ethers, and some polyfluoroalkyl substances) are declining[15], Inuit are still exposed to considerably higher levels of these contaminants than the Canadian general population, and some emerging POP are increasing cause for concern. Meanwhile, harvesting, preparing and consuming CF introduce unique risks of some zoonotic pathogens, including *Toxoplasma gondii*, *Trichinella spp.* and *Clostridium botulinum*[171–183]. Thus, a serious challenge for public health practitioners, regulators, academics and Inuit communities is supporting, maintaining and promoting the cultural, social and nutritional health benefits of CF harvesting and consumption while also minimising exposure to harmful contaminants and zoonoses, particularly in the context of global environmental change[15,200,201]. This challenge has been acknowledged by several authors[17,28,30,39,166] and organisations[15,202]. A parallel challenge to risk assessment is risk communication, which must be done cautiously to avoid exaggerated fears of CF consumption[203–206]. A nascent body of research uses mathematical modelling to investigate the trade-offs of CF and MF based on food availability, cultural appropriateness, nutrition and health outcomes, and economic feasibility[17]. Such techniques have informed specific recommendations for food substitutions using food replacement modelling[17,45,57,206,207]. For example, Calder and colleagues suggested that replacing CF with locally caught Atlantic salmon will lead to net benefits for neurodevelopmental and cardiovascular health and reduced risk of cancer in three communities in Nunatsiavut[45]. However, a notable gap is the frequent failure of such models to account for the complex interactions between CF nutrients and contaminants (e.g. Se and *n*-3 PUFA may mitigate the harmful effects of MeHg and dietary calcium may mitigate Pb absorption and toxicity), risks of zoonoses and the less tangible benefits of CF harvesting, sharing and consumption which include cultural, social and mental health dimensions[126,127,208,209]. Future modelling research should therefore incorporate community-identified priorities in an attempt to weigh all possible benefits and risks of CF against available MF. Thus, it is crucial that Inuit partners, researchers across disciplines and public health practitioners collaborate to develop culturally appropriate risk assessment and communication strategies grounded in Inuit Qaujimajatuqangit (knowledge) and scientific knowledge.

A number of gaps were identified that comprise possible avenues for further investigation (Box 2). A major concern is the limited research conducted in Inuit communities that directly assesses existing coping mechanisms and Inuit-led adaptations or solutions to challenges posed by dietary transitions. There is a need to better evaluate the feasibility and possible structures of community-led initiatives that address drivers of the dietary transition and subsequent health implications. Community-based nutrition interventions targeting retail food systems and food education have been shown to improve dietary adequacy, nutrition knowledge and food-related self-efficacy and intentions[32,61,77,78]. Community food programmes, such as food banks, soup kitchens and community freezers, have successfully alleviated severe food insecurity and improved access to culturally appropriate foods in many northern communities[61,78]. However, such initiatives (and evaluations of their effectiveness) are far from ubiquitous in Inuit communities, and there is a need to support community capacity to establish and evaluate such programmes. There is also a notable

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

Box 2: Gaps in research on drivers and implications of the dietary transition among Inuit

- There is a need to harmonise the priorities of academic research with those of Inuit communities and organisations
- Very little published research actively incorporates Inuit Qaujimajatuqangit (knowledge) into data collection and analysis methods, reporting and recommendations
- While many studies boasted engagement with Inuit communities as a key component of project development, there was little standardisation across articles for what constituted engagement and how this was reported
- While many successive cross-sectional studies have examined dietary intake, dietary adequacy and health outcomes in Inuit communities, there have been few longitudinal studies to confirm and monitor long-term dietary and lifestyle changes and subsequent impacts on health
- Future research should explore the relative contributions of dietary and lifestyle changes for increasing burdens of obesity and related non-communicable diseases
- There is a necessity for harmonisation and standardisation of methods for assessing dietary intake, food security, health outcomes and northern food environments for better comparisons across populations and time periods[212]
- Future research should assess the causes of gender- and age-based differences in traditional food consumption across Inuit communities[25]
- Risk assessments and risk-benefit analyses (including food replacement models) of traditional foods tend to focus on one or a few exposures (e.g. environmental contaminants) and outcomes (e.g. physical health)[207,208]. No studies have attempted to conduct actionable risk-benefit analyses of the trade-offs between traditional food and MF consumption that simultaneously incorporate multiple dimensions of health (e.g. physical, mental, spiritual and cultural), cost effectiveness, local/regional realities, feasibility, sustainability and food preferences
- There is a need to prioritise research on the impacts of climate change on accessibility, availability and affordability of CF and MF and potential adaptation strategies to mitigate the risks of climate-mediated diet-related risks to Inuit health and well-being and integrate these issues in the risk-benefit analyses
- There is a need to evaluate the necessity, feasibility and possible structures of community-led initiatives that provide solutions to challenges posed by the dietary transition to simultaneously reduce food insecurity and improve nutritional health while aligning with Inuit preferences, traditions and priorities

lack of research that addresses economic and structural constraints (e.g. food environments) as key determinants of food insecurity, food choices and nutritional health[210,211].

Finally, there is a crucial gap between the priorities of existing academic literature and those of Inuit communities and organisations. While there is a substantial body of academic literature assessing dietary adequacy, epidemiological trends and environmental contaminants in CF across Inuit Nunangat, very little published research is explicitly grounded in Inuit priorities, embodies participatory action research or other approaches that centralise Inuit experiences and collective action, or incorporates Inuit authorship. Recent Inuit-led consultations and publications have called for a food sovereignty approach that includes increased harvester-enabling infrastructure and harvester support and steward programmes, including wages for harvesters, funding for equipment and supplies, and skills development/mentorship programmes[205,212–214]. Such priorities and potential interventions have received little attention from published academic literature; there is therefore considerable need to align the approaches of academic research with those of Inuit communities to unify resources, skills, evidence and voices.

Limitations

Several limitations of the current study should be acknowledged. Due to a limited systematic search strategy for identifying sources from grey literature, the findings may be biased towards academic and Western-derived knowledge while excluding other forms of information, such as Indigenous knowledge reports published by institutions outside academia. Furthermore, while the search strategy was wide-ranging, it was informed by pre-conceived notions of terms relevant to the research question, thereby possibly excluding relevant articles and research themes. Finally, as is common with the scoping review methodology, we did not assess any measures of study or data quality, so it is possible that biases present in included articles translated into similar biases in this review[215].

Conclusion

Canadian Inuit have undergone profound cultural, social and environmental changes that have undermined traditional ways of life and driven a dietary transition from primarily CF to MF in a short period of time. The health implications of this dietary transition are complex.

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

Anaemia, overweight and obesity, and cardiometabolic health outcomes (e.g. hypertension, type 2 diabetes and CVD) are serious public health concerns. Declining traditional food consumption may also exacerbate mental and psychological health problems associated with the trauma of the loss of cultural and social traditions. However, CF can be a source of environmental contaminants, and declining CF consumption has been paralleled by reductions in population-level body burdens of POP, MeHg, and Pb. As of yet, it is relatively unknown to what extent this trend is due to reduced levels in CF themselves, declining consumption of certain CF or shifting patterns from some CF to others. There is a need for further research on activities that simultaneously promote the consumption of CF and healthy MF to reduce food insecurity and improve nutritional health in a way that is culturally appropriate and grounded in Inuit priorities. This is a monumental task that will require strong partnerships between Inuit, researchers, practitioners and policymakers. A combination of localised research, community-driven health and food policies, community-based monitoring and supports, and global activism will be required to address the complex health burdens driven by the dietary transition among Inuit populations.

Acknowledgements

Acknowledgements: The authors would like to acknowledge the participants who have contributed to research conducted with Inuit communities across the Canadian North. Additionally, the authors would like to thank the Nunavik Nutrition and Health Committee for their contributions to the manuscript revisions. *Financial support:* Financial support was provided by Health Canada through a private contract (no grant number). *Conflict of interest:* The authors declare no conflicts of interest. *Authorship:* M. Little conceptualised the review, conducted the literature search, screened articles for eligibility, reviewed full-text articles, conducted thematic analysis, wrote the manuscript and responded to manuscript revisions. H.H. screened articles for eligibility, reviewed full-text articles, extracted study characteristics, performed an analysis of study characteristics, developed all figures and provided comments on manuscript drafts. C.Z. screened articles for eligibility, resolved screening conflicts and provided comments on manuscript drafts. W.D. co-wrote some sections of the manuscript, provided comments on manuscript drafts, provided editorial assistance and assisted with responding to manuscript revisions. K.S. provided conceptual oversight of the review, consulted on review protocol, provided comments on manuscript drafts and assisted with responding to manuscript revisions. T.-A.K. provided conceptual oversight of the review, co-wrote some sections of the manuscript, provided comments on manuscript drafts and assisted with responding to manuscript revisions. A.C. provided extensive insight from a northern perspective on the review protocol and thematic analysis, provided comments on manuscript drafts and assisted with responding to manuscript revisions. J.G. screened some articles for eligibility, resolved screening conflicts, provided editorial oversight of manuscript drafts and assisted with responding to manuscript revisions. M. Lemire provided conceptual oversight of the review, consulted on review protocol, co-wrote some sections of the manuscript, provided comments on manuscript drafts and assisted with responding to manuscript revisions. *Ethics of human subject participation:* This manuscript does not include primary research involving human participants.

Supplementary material

For supplementary material accompanying this paper visit https://doi.org/10.1017/S1368980020002402

References

1. Sharma S, Hopping BN, Roache C *et al.* (2013) Nutrient intakes, major food sources and dietary inadequacies of Inuit adults living in three remote communities in Nunavut, Canada. *J Hum Nutr Diet* **26**, 578–586.
2. Singer J, Putulik Kidlapik C, Martin B *et al.* (2014) Food consumption, obesity and abnormal glycaemic control in a Canadian Inuit community. *Clin Obes* **4**, 316–323.
3. Blanchet C & Rochette L (2008) *Nutrition and Food Consumption among the Inuit of Nunavik. Nunavik Inuit Health Survey 2004, Qanuippitaa? How are We?* Quebec: Institut national de santé publique du Québec (INSPQ) and Nunavik Regional Board of Health and Social Services (NRBHSS).
4. Egeland GM, Johnson-Down L, Cao ZR *et al.* (2011) Food insecurity and nutrition transition combine to affect nutrient intakes in Canadian arctic communities. *J Nutr* **141**, 1746–1753.
5. Gagne D, Blanchet R, Lauziere J *et al.* (2012) Traditional food consumption is associated with higher nutrient intakes in Inuit children attending childcare centres in Nunavik. *Int J Circumpolar Health* **71**, 18401.
6. Kellett S, Poirier P, Dewailly E *et al.* (2012) Is severe obesity a cardiovascular health concern in the Inuit population? *Am J Hum Biol* **24**, 441–445.
7. Pufall EQ, Jones A, McEwen S *et al.* (2011) Perception of the importance of traditional country foods to the physical, mental, and spiritual health of Labrador Inuit. *Arctic* **64**, 242–250.
8. Kuhnlein HV & Receveur O (2007) Local cultural animal food contributes high levels of nutrients for Arctic Canadian Indigenous adults and children. *J Nutr* **137**, 1110–1114.
9. Singh K, Bjerregaard P & Chan HM (2014) Association between environmental contaminants and health outcomes in Indigenous populations of the Circumpolar North. *Int J Circumpolar Health* **73**, 25808.
10. Levac D, Colquhoun H & O'Brien KK (2010) Scoping studies: advancing the methodology. *Implement Sci* **5**, 69.
11. Arksey H & O'Malley L (2005) Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* **8**, 19–32.

12. Dijkers M (2015) What is a scoping review? *KT Update* **4**, 1–5.
13. Tricco AC, Lillie E, Zarin W *et al.* (2018) PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med* **169**, 467–473.
14. Inuit Tapiriit Kanatami (ITK) (2016) Inuit Communities of Canada. https://www.itk.ca/wp-content/uploads/2016/07/Inuit_communities_of_Canada.pdf (accessed March 2019).
15. Arctic Monitoring and Assessment Program (AMAP) (2015) *AMAP Assessment 2015: Human Health in the Arctic*. Oslo: Arctic Council.
16. Donaldson SG, Van Oostdam J, Tikhonov C *et al.* (2010) Environmental contaminants and human health in the Canadian Arctic. *Sci Total Environ* **408**, 5165–5234.
17. Laird BD, Goncharov AB, Egeland GM *et al.* (2013) Dietary advice on Inuit traditional food use needs to balance benefits and risks of mercury, selenium, and *n*3 fatty acids. *J Nutr* **143**, 923–930.
18. Van Oostdam J, Donaldson SG, Feeley M *et al.* (2005) Human health implications of environmental contaminants in Arctic Canada: a review. *Sci Total Environ* **351–352**, 165–246.
19. McHugh ML (2012) Interrater reliability: the kappa statistic. *Biochem Med (Zagreb)* **22**, 276–282.
20. Braun V & Clarke V (2006) Using thematic analysis in psychology. *Qual Res Psychol* **3**, 77–101.
21. Boyatzis RE (1998) *Transforming Qualitative Information: Thematic Analysis and Code Development*. New Delhi: Sage Publications.
22. Kuhnlein HV, Receveur O, Soueida R *et al.* (2004) Arctic Indigenous peoples experience the nutrition transition with changing dietary patterns and obesity. *J Nutr* **134**, 1447–1453.
23. Dewailly E, Blanchet C, Lemieux S *et al.* (2001) *n*-3 fatty acids and CVD risk factors among the Inuit of Nunavik. *Am J Clin Nutr* **74**, 464–473.
24. Blanchet C, Dewailly E, Ayotte P *et al.* (2000) Contribution of selected traditional and market foods to the diet of Nunavik Inuit Women. *Can J Diet Pract Res* **61**, 50–59.
25. Sheikh N, Egeland GM, Johnson-Down L *et al.* (2011) Changing dietary patterns and BMI over time in Canadian Inuit communities. *Int J Circumpolar Health* **70**, 511–519.
26. Richmond CA (2009) The social determinants of Inuit health: a focus on social support in the Canadian Arctic. *Int J Circumpolar Health* **68**, 471–487.
27. Egeland GM, Pacey A, Cao Z *et al.* (2010) Food insecurity among Inuit preschoolers: Nunavut Inuit Child Health Survey, 2007–2008. *Can Med Assoc J* **182**, 243–248.
28. Pacey A, Nancarrow T & Egeland G (2010) Prevalence and risk factors for parental-reported oral health of Inuit preschoolers: Nunavut Inuit Child Health Survey, 2007–2008. *Rural Remote Health* **10**, 1368.
29. Sharma S (2010) Assessing diet and lifestyle in the Canadian Arctic Inuit and Inuvialuit to inform a nutrition and physical activity intervention programme. *J Hum Nutr Diet* **23**, Suppl. 1, 5–17.
30. Mead E, Gittelsohn J, Roache C *et al.* (2010) Healthy food intentions and higher socioeconomic status are associated with healthier food choices in an Inuit population. *J Hum Nutr Diet* **23**, 83–91.
31. Bains A, Pakseresht M, Roache C *et al.* (2014) Healthy foods North improves diet among Inuit and Inuvialuit women of childbearing age in Arctic Canada. *J Hum Nutr Diet* **27**, 175–185.
32. Mead EL, Gittelsohn J, Roache C *et al.* (2013) A community-based, environmental chronic disease prevention intervention to improve healthy eating psychosocial factors and behaviors in indigenous populations in the Canadian Arctic. *Health Educ Behav* **40**, 592–602.
33. Dallaire F, Dewailly E, Shademani R *et al.* (2003) Vitamin A concentration in umbilical cord blood of infants from three separate regions of the province of Quebec (Canada). *Can J Public Health* **94**, 386–390.
34. Gagné D, Blanchet R, Vaissière É *et al.* (2013) Impact of a childcare centre nutrition program: on nutrient intakes in Nunavik Inuit children. *Can J Diet Pract Res* **74**, e311–e317.
35. Mayhall J (1973) Canadian Inuit Odontological Investigations 1968–1973. *Int Biol Progr Hum Adap Proj* **73**, 242–284.
36. Mayhall JT (1977) The oral health of a Canadian Inuit community: an anthropological approach. *J Dent Res* **56**, 55–61.
37. Ellestad-Sayed J, Haworth J & Hildes J (1978) Disaccharide malabsorption and dietary patterns in two Canadian Eskimo communities. *Am J Clin Nutr* **31**, 1473–1478.
38. Kenny TA, Hu XF, Kuhnlein HV *et al.* (2018) Dietary sources of energy and nutrients in the contemporary diet of Inuit adults: results from the 2007–08 Inuit Health Survey. *Public Health Nutr* **21**, 1319–1331.
39. Kuhnlein HV (1995) Benefits and risks of traditional food for Indigenous Peoples: focus on dietary intakes of Arctic men. *Can J Physiol Pharmacol* **73**, 765–771.
40. Kuhnlein HV, Soueida R & Receveur O (1996) Dietary nutrient profiles of Canadian Baffin Island Inuit differ by food source, season, and age. *J Am Diet Assoc* **96**, 155–162.
41. Proust F, Lucas M & Dewailly É (2014) Fatty acid profiles among the Inuit of Nunavik: current status and temporal change. *Prostag Leukot Ess Fatty Acids* **90**, 159–167.
42. Sharma S, Cao X, Roache C *et al.* (2010) Assessing dietary intake in a population undergoing a rapid transition in diet and lifestyle: the Arctic Inuit in Nunavut, Canada. *Br J Nutr* **103**, 749–759.
43. Sharma S, De Roose E, Cao X *et al.* (2009) Dietary intake in a population undergoing a rapid transition in diet and lifestyle: the Inuvialuit in the Northwest Territories of Arctic Canada. *Can J Public Health* **100**, 442–448.
44. Santé Québec (1995) A Health Profile of the Inuit: Report of the Santé Québec Health Survey among the Inuit of Nunavik, 1992. Part III: Diet, A Health Determining Factor. Montreal: Ministère de la Santé et des Services Sociaux, Gouvernement du Québec.
45. Calder RS, Bromage S & Sunderland EM (2019) Risk trade-offs associated with traditional food advisories for Labrador Inuit. *Environ Res* **168**, 496–506.
46. Sheehy T, Roache C & Sharma S (2013) Eating habits of a population undergoing a rapid dietary transition: portion sizes of traditional and non-traditional foods and beverages consumed by Inuit adults in Nunavut, Canada. *Nutr J* **12**, 70.
47. Erber E, Beck L, Hopping BN *et al.* (2010) Food patterns and socioeconomic indicators of food consumption amongst Inuvialuit in the Canadian Arctic. *J Hum Nutr Diet* **23**, Suppl. 1, 59–66.
48. Erber E, Hopping BN, Beck L *et al.* (2010) Assessment of dietary adequacy in a remote Inuvialuit population. *J Hum Nutr Diet* **23**, Suppl. 1, 35–42.
49. Mead E, Gittelsohn J, De Roose E *et al.* (2010) Important psychosocial factors to target in nutrition interventions to improve diet in Inuvialuit communities in the Canadian Arctic. *J Hum Nutr Diet* **23**, Suppl. 1, 92–99.
50. Zotor F, Sheehy T, Lupu M *et al.* (2012) Frequency of consumption of foods and beverages by Inuvialuit adults in Northwest Territories, Arctic Canada. *Int J Food Sci Nutr* **63**, 782–789.
51. Hopping BN, Erber E, Mead E *et al.* (2010) Socioeconomic indicators and frequency of traditional food, junk food, and fruit and vegetable consumption amongst Inuit adults in the Canadian Arctic. *J Hum Nutr Diet* **23**, Suppl. 1, 51–58.
52. Hopping BN, Mead E, Erber E *et al.* (2010) Dietary adequacy of Inuit in the Canadian Arctic. *J Hum Nutr Diet* **23**, Suppl. 1, 27–34.

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

53. Berti PR, Hamilton SE, Receveur O *et al.* (1999) Food use and nutrient adequacy in Baffin Inuit children and adolescents. *Can J Diet Pract Res* **60**, 63–70.
54. Galloway T, Johnson-Down L & Egeland GM (2015) Socioeconomic and cultural correlates of diet quality in the Canadian Arctic: results from the 2007–2008 Inuit Health Survey. *Can J Diet Pract Res* **76**, 117–125.
55. Kuhnlein HV, Receveur O, Soueida R *et al.* (2008) Unique patterns of dietary adequacy in three cultures of Canadian Arctic Indigenous peoples. *Public Health Nutr* **11**, 349–360.
56. Huet C, Ford JD, Edge VL *et al.* (2017) Food insecurity and food consumption by season in households with children in an Arctic city: a cross-sectional study. *BMC Public Health* **17**, 578–578.
57. Rosol R, Huet C, Wood M *et al.* (2011) Prevalence of affirmative responses to questions of food insecurity: International Polar Year Inuit Health Survey, 2007–2008. *Int J Circumpolar Health* **70**, 488–497.
58. Condon RG, Collings P & Wenzel G (1995) The best part of life: subsistence hunting, ethnicity, and economic adaptation among young adult Inuit males. *Arctic* **48**, 31–46.
59. Akande VO, Hendriks AM, Ruiter RA *et al.* (2015) Determinants of dietary behavior and physical activity among Canadian Inuit: a systematic review. *Int J Behav Nutr Phys Act* **12**, 84.
60. Kuhnlein HV (1991) Nutrition of the Inuit: a brief overview. *Arctic Med Res* **8**, 9.
61. Ford JD, Lardeau M-P, Blackett H *et al.* (2013) Community food program use in Inuvik, Northwest Territories. *BMC Public Health* **13**, 970.
62. Gittelsohn J, Roache C, Kratzmann M *et al.* (2010) Participatory research for chronic disease prevention in Inuit communities. *Am J Health Behav* **34**, 453–464.
63. Harper SL, Edge VL, Ford J *et al.* (2015) Climate-sensitive health priorities in Nunatsiavut, Canada. *BMC Public Health* **15**, 605.
64. Lambden J, Receveur O & Kuhnlein HV (2007) Traditional food attributes must be included in studies of food security in the Canadian Arctic. *Int J Circumpolar Health* **66**, 308–319.
65. Mead E, Gittelsohn J, Kratzmann M *et al.* (2010) Impact of the changing food environment on dietary practices of an Inuit population in Arctic Canada. *J Hum Nutr Diet* **23**, Suppl. 1, 18–26.
66. Counil E, Gauthier MJ, Blouin V *et al.* (2012) Translational research to reduce trans-fat intakes in Northern Quebec (Nunavik) Inuit communities: a success story? *Int J Circumpolar Health* **71**, 18833.
67. King U & Furgal C (2014) Is hunting still healthy? Understanding the interrelationships between indigenous participation in land-based practices and human-environmental health. *Int J Circumpolar Health* **11**, 5751–5782.
68. Martin DH (2011) 'Now we got lots to eat and they're telling us not to eat it': understanding changes to south-east Labrador Inuit relationships to food. *Int J Circumpolar Health* **70**, 384–395.
69. Sheehy T, Kolahdooz F, Roache C *et al.* (2014) Changing dietary patterns in the Canadian Arctic: frequency of consumption of foods and beverages by Inuit in three Nunavut communities. *Food Nutr Bull* **35**, 244–252.
70. Pauktuutit Inuit Women of Canada (2006) The Inuit way; a guide to Inuit culture. http://www.uqar.ca/files/boreas/inuitway_e.pdf (accessed March 2019).
71. Kenny TA, Fillion M, Simpkin S *et al.* (2018) Caribou (*Rangifer tarandus*) and Inuit Nutrition Security in Canada. *EcoHealth* **15**, 590–607.
72. Loring PA & Gerlach SC (2015) Searching for progress on food security in the North American North: a research synthesis and meta-analysis of the peer-reviewed literature. *Arctic* **68**, 380–392.
73. Pearce T, Ford JD, Caron A *et al.* (2012) Climate change adaptation planning in remote, resource-dependent communities: an Arctic example. *Reg Environ Change* **12**, 825–837.
74. Ford JD, Macdonald JP, Huet C *et al.* (2016) Food policy in the Canadian North: is there a role for country food markets? *Soc Sci Med* **152**, 35–40.
75. Sheehy T, Kolahdooz F, Schaefer SE *et al.* (2015) Traditional food patterns are associated with better diet quality and improved dietary adequacy in Aboriginal peoples in the Northwest Territories, Canada. *J Hum Nutr Diet* **28**, 262–271.
76. Chan HM, Fediuk K, Hamilton S *et al.* (2006) Food security in Nunavut, Canada: barriers and recommendations. *Int J Circumpolar Health* **65**, 416–431.
77. Kolahdooz F, Pakseresht M, Mead E *et al.* (2014) Impact of the healthy foods North nutrition intervention program on Inuit and Inuvialuit food consumption and preparation methods in Canadian Arctic communities. *Nutr J* **13**, 68.
78. Organ J, Castleden H, Furgal C *et al.* (2014) Contemporary programs in support of traditional ways: inuit perspectives on community freezers as a mechanism to alleviate pressures of wild food access in Nain, Nunatsiavut. *Health Place* **30**, 251–259.
79. Goldhar C, Bell T & Wolf J (2014) Vulnerability to freshwater changes in the Inuit settlement region of Nunatsiavut, Labrador: a case study from Rigolet. *Arctic* **67**, 71–83.
80. Ford J, Lardeau M-P & Vanderbilt W (2012) The characteristics and experience of community food program users in arctic Canada: a case study from Iqaluit, Nunavut. *BMC Public Health* **12**, 464.
81. Beaumier MC & Ford JD (2010) Food insecurity among Inuit women exacerbated by socio-economic stresses and climate change. *Can J Public Health* **101**, 196–201.
82. Ford JD & Beaumier M (2011) Feeding the family during times of stress: experience and determinants of food insecurity in an Inuit community. *Geogr J* **177**, 44–61.
83. Huet C, Rosol R & Egeland GM (2012) The prevalence of food insecurity is high and the diet quality poor in Inuit communities. *J Nutr* **142**, 541–547.
84. Pakseresht M, Lang R, Rittmueller S *et al.* (2014) Food expenditure patterns in the Canadian Arctic show cause for concern for obesity and chronic disease. *Int J Behav Nutr Phys Act* **11**, 51–51.
85. Ruiz-Castell M, Muckle G, Dewailly E *et al.* (2015) Household crowding and food insecurity among Inuit families with school-aged children in the Canadian Arctic. *Am J Public Health* **105**, e122–132.
86. Lardeau MP, Healey G & Ford J (2011) The use of photovoice to document and characterize the food security of users of community food programs in Iqaluit, Nunavut. *Rural Remote Health* **11**, 1680.
87. Egeland GM, Faraj N & Osborne G (2010) Cultural, socioeconomic, and health indicators among Inuit preschoolers: Nunavut Inuit Child Health Survey, 2007–2008. *Rural Remote Health* **10**, 1365.
88. Sheppard AJ & Hetherington R (2012) A decade of research in Inuit children, youth, and maternal health in Canada: areas of concentrations and scarcities. *Int J Circumpolar Health* **71**, 18383–18383.
89. Counil E, Julien P, Lamarche B *et al.* (2009) Association between trans-fatty acids in erythrocytes and pro-atherogenic lipid profiles among Canadian Inuit of Nunavik: possible influences of sex and age. *Br J Nutr* **102**, 766–776.
90. Searles E (2002) Food and the making of modern Inuit identities. *Food Foodways* **10**, 55–78.

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

91. Cunsolo Willox A, Harper SL, Ford JD *et al.* (2012) 'From this place and of this place:' climate change, sense of place, and health in Nunatsiavut, Canada. *Soc Sci Med* **75**, 538–547.
92. Furgal C & Seguin J (2006) Climate change, health, and vulnerability in Canadian northern Aboriginal communities. *Environ Health Perspect* **114**, 1964–1970.
93. Nancarrow TL & Chan HM (2010) Observations of environmental changes and potential dietary impacts in two communities in Nunavut, Canada. *Rural Remote Health* **10**, 1370.
94. Rosol R, Powell-Hellyer S & Chan HM (2016) Impacts of decline harvest of country food on nutrient intake among Inuit in Arctic Canada: impact of climate change and possible adaptation plan. *Int J Circumpolar Health* **75**, 31127–31127.
95. Wesche SD & Chan HM (2010) Adapting to the impacts of climate change on food security among Inuit in the Western Canadian Arctic. *EcoHealth* **7**, 361–373.
96. Parkinson AJ & Butler JC (2005) Potential impacts of climate change on infectious diseases in the Arctic. *Int J Circumpolar Health* **64**, 478–486.
97. Schaefer SE, Erber E, Trzaskos JP *et al.* (2011) Sources of food affect dietary adequacy of Inuit women of childbearing age in Arctic Canada. *J Health Popul Nutr* **29**, 454–464.
98. Jamieson JA, Kuhnlein HV, Weiler HA *et al.* (2013) Higher n3-fatty acid status is associated with lower risk of iron depletion among food insecure Canadian Inuit women. *BMC Public Health* **13**, 289.
99. Kolahdooz F, Barr A, Roache C *et al.* (2013) Dietary adequacy of vitamin D and calcium among Inuit and Inuvialuit women of child-bearing age in Arctic Canada: a growing concern. *PLoS One* **8**, e78987.
100. Lemire M, Kwan M, Laouan-Sidi AE *et al.* (2015) Local country food sources of methylmercury, selenium and omega-3 fatty acids in Nunavik, Northern Quebec. *Sci Total Environ* **509–510**, 248–259.
101. Findlay LC, Langlois KA & Kohen DE (2013) Hunger among Inuit children in Canada. *Int J Circumpolar Health* **72**. doi: 10.3402/ijch.v3472i3400.20.324.
102. Pirkle CM, Lucas M, Dallaire R *et al.* (2014) Food insecurity and nutritional biomarkers in relation to stature in Inuit children from Nunavik. *Can J Public Health* **105**, 233–238.
103. Tse SM, Weiler H & Kovesi T (2016) Food insecurity, vitamin D insufficiency and respiratory infections among Inuit children. *Int J Circumpolar Health* **75**, 29954–29954.
104. St-Germain A-AF, Galloway T & Tarasuk V (2019) Food insecurity in Nunavut following the introduction of Nutrition North Canada. *Can Med Assoc J* **191**, E552–E558.
105. Statistics Canada (2015) Household food insecurity, 2011–2012. https://www150.statcan.gc.ca/n1/pub/82–625-x/2013001/article/11889-eng.htm (accessed March 2019).
106. Guo Y, Berrang-Ford L, Ford J *et al.* (2015) Seasonal prevalence and determinants of food insecurity in Iqaluit, Nunavut. *Int J Circumpolar Health* **74**, 27284–27284.
107. Canadian Medical Association (1976) The Nutrition Canada Survey: a review. Statement by the Nutrition Committee of the Canadian Paediatric Society. *Can Med Assoc J* **115**, 775–777.
108. Berti PR, Soueida R & Kuhnlein HV (2008) Dietary assessment of Indigenous Canadian Arctic women with a focus on pregnancy and lactation. *Int J Circumpolar Health* **67**, 349–362.
109. Duncan K, Erickson AC, Egeland GM *et al.* (2018) Red blood cell folate levels in Canadian Inuit women of childbearing years: influence of food security, BMI, smoking, education, and vitamin use. *Can J Public Health* **109**, 684–691.
110. Egeland GM, Berti P, Soueida R *et al.* (2004) Age differences in vitamin A intake among Canadian Inuit. *Can J Public Health* **95**, 465–469.
111. El Hayek Fares J & Weiler HA (2016) Implications of the nutrition transition for vitamin D intake and status in Aboriginal groups in the Canadian Arctic. *Nutr Rev* **74**, 571–583.
112. El Hayek J, Egeland G & Weiler H (2010) Vitamin D status of Inuit preschoolers reflects season and vitamin D intake. *J Nutr* **140**, 1839–1845.
113. Johnson-Down L & Egeland GM (2010) Adequate nutrient intakes are associated with traditional food consumption in Nunavut Inuit children aged 3–5 years. *J Nutr* **140**, 1311–1316.
114. Kolahdooz F, Spearing K, Corriveau A *et al.* (2013) Dietary adequacy and alcohol consumption of Inuvialuit women of child-bearing age in the Northwest Territories, Canada. *J Hum Nutr Diet* **26**, 570–577.
115. Rittmueller SE, Corriveau A & Sharma S (2012) Differences in dietary quality and adequacy by smoking status among a Canadian Aboriginal population. *Public Health* **126**, 490–497.
116. Waiters B, Godel JC & Basu TK (1999) Perinatal vitamin D and calcium status of northern Canadian mothers and their newborn infants. *J Americ Coll Nutr* **18**, 122–126.
117. Jamieson JA & Kuhnlein HV (2008) The paradox of anemia with high meat intake: a review of the multifactorial etiology of anemia in the Inuit of North America. *Nutr Rev* **66**, 256–271.
118. Christofides A, Schauer C & Zlotkin SH (2005) Iron deficiency and anemia prevalence and associated etiologic risk factors in First Nations and Inuit communities in Northern Ontario and Nunavut. *Can J Public Health* **96**, 304–307.
119. Plante C, Blanchet C, Rochette L *et al.* (2011) Prevalence of anemia among Inuit women in Nunavik, Canada. *Int J Circumpolar Health* **70**, 154–165.
120. Zhou YE, Kubow S & Egeland GM (2011) Is iron status associated with highly unsaturated fatty acid status among Canadian Arctic Inuit? *Food Funct* **2**, 381–385.
121. Pacey A, Weiler H & Egeland GM (2011) Low prevalence of iron-deficiency anaemia among Inuit preschool children: Nunavut Inuit Child Health Survey, 2007–2008. *Public Health Nutr* **14**, 1415–1423.
122. Egeland GM, Williamson-Bathory L, Johnson-Down L *et al.* (2011) Traditional food and monetary access to market-food: correlates of food insecurity among Inuit preschoolers. *Int J Circumpolar Health* **70**, 373–383.
123. Jamieson JA, Weiler HA, Kuhnlein HV *et al.* (2012) Traditional food intake is correlated with iron stores in Canadian Inuit men. *J Nutr* **142**, 764–770.
124. Jamieson JA, Weiler HA, Kuhnlein HV *et al.* (2016) Prevalence of unexplained anaemia in Inuit men and Inuit post-menopausal women in Northern Labrador: International Polar Year Inuit Health Survey. *Can J Public Health* **107**, e81–e87.
125. Blanchet R, Lauziere J, Gagne D *et al.* (2014) Usual dietary fatty acid intakes and red-blood-cell membrane fatty acid composition in Inuit children attending child-care centres in Nunavik, northern Quebec, Canada. *Public Health Nutr* **17**, 2844–2852.
126. Hu XF, Eccles KM & Chan HM (2017) High selenium exposure lowers the odds ratios for hypertension, stroke, and myocardial infarction associated with mercury exposure among Inuit in Canada. *Environ Int* **102**, 200–206.
127. Hu XF, Sharin T & Chan HM (2017) Dietary and blood selenium are inversely associated with the prevalence of stroke among Inuit in Canada. *J Trace Elem Med Biol* **44**, 322–330.
128. Zhou YE, Kubow S & Egeland GM (2011) Highly unsaturated *n*-3 fatty acids status of Canadian Inuit: International Polar Year Inuit Health Survey, 2007–2008. *Int J Circumpolar Health* **70**, 498–510.

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

129. Achouba A, Dumas P, Ouellet N *et al.* (2016) Plasma levels of selenium-containing proteins in Inuit adults from Nunavik. *Environ Int* **96**, 8–15.
130. Lucas M, Proust F, Blanchet C *et al.* (2010) Is marine mammal fat or fish intake most strongly associated with omega-3 blood levels among the Nunavik Inuit? *Prostag Leukotrs Ess Fatty Acids* **83**, 143–150.
131. Boucher O, Burden MJ, Muckle G *et al.* (2011) Neurophysiologic and neurobehavioral evidence of beneficial effects of prenatal omega-3 fatty acid intake on memory function at school age. *Am J Clin Nutr* **93**, 1025–1037.
132. El Hayek J, Egeland G & Weiler H (2012) Higher body mass, older age and higher MUFA intake reflect better quantitative ultrasound parameters in Inuit preschoolers. *Int J Circumpolar Health* **71**, 18999.
133. Hu XF, Laird BD & Chan HM (2017) Mercury diminishes the cardiovascular protective effect of omega-3 PUFA in the modern diet of Inuit in Canada. *Environ Res* **152**, 470–477.
134. Lucas M, Dewailly E, Blanchet C *et al.* (2009) Plasma omega-3 and psychological distress among Nunavik Inuit (Canada). *Psych Res* **167**, 266–278.
135. Lucas M, Dewailly É, Muckle G *et al.* (2004) Gestational age and birth weight in relation to *n*–3 fatty acids among inuit (Canada). *Lipids* **39**, 617–626.
136. Lucas M, Kirmayer LJ, Dery S *et al.* (2010) Erythrocyte *n*-3 is inversely correlated with serious psychological distress among the Inuit: data from the Nunavik health survey. *J Am Coll Nutr* **29**, 211–221.
137. Paunescu A, Ayotte P, Dewailly E *et al.* (2014) Saturated and monounsaturated fatty acid status is associated with bone strength estimated by calcaneal ultrasonography in Inuit women from Nunavik (Canada): a cross-sectional study. *J Nutr Health Ageing* **18**, 663–671.
138. Skogli HR, Geoffroy D, Weiler HA *et al.* (2017) Associations between omega-3 fatty acids and 25(OH)D and psychological distress among Inuit in Canada. *Int J Circumpolar Health* **76**, 1302684.
139. Valera B, Dewailly E, Anassour-Laouan-Sidi E *et al.* (2011) Influence of *n*-3 fatty acids on cardiac autonomic activity among Nunavik Inuit adults. *Int J Circumpolar Health* **70**, 6–18.
140. Schaefer O, Timmermans J, Eaton R *et al.* (1980) General and nutritional health in two Eskimo populations at different stages of acculturation. *Can J Public Health* **71**, 397–405.
141. Thouez J, Rannou A & Foggin P (1989) The other face of development: native population, health status and indicators of malnutrition—the case of the Cree and Inuit of northern Quebec. *Soc Sci Med* **29**, 965–974.
142. Galloway T, Young TK & Egeland GM (2010) Emerging obesity among preschool-aged Canadian Inuit children: results from the Nunavut Inuit Child Health Survey. *Int J Circumpolar Health* **69**, 151–157.
143. Hopping B, Erber E, Beck L *et al.* (2010) Inuvialuit adults in the Canadian Arctic have a high BMI and self-reported physical activity. *J Hum Nutr Diet* **23**, 115–119.
144. Charbonneau-Roberts G & Young K (2007) Inuit anthropometry and insulin resistance. *Int J Circumpolar Health* **66**, 129–134.
145. Chateau-Degat M-L, Dewailly É, Louchini R *et al.* (2010) Cardiovascular burden and related risk factors among Nunavik (Quebec) Inuit: insights from baseline findings in the circumpolar Inuit health in transition cohort study. *Can J Cardiol* **26**, e190–e196.
146. Hopping BN, Erber E, Mead E *et al.* (2010) High levels of physical activity and obesity co-exist amongst Inuit adults in Arctic Canada. *J Hum Nutr Diet* **23**, Suppl. 1, 110–114.
147. Egeland GM, Cao Z & Young TK (2011) Hypertriglyceridemic-waist phenotype and glucose intolerance among Canadian Inuit: the International Polar Year Inuit Health Survey for Adults 2007–2008. *CMAJ* **183**, E553–E558.
148. Panagiotopoulos C, Nguyen D & Smith J (2014) Cardiovascular risk factors and health behaviours in elementary school-age Inuvialuit and Gwich'in children. *Paediatr Child Health* **19**, 256–260.
149. Medehouenou TC, Ayotte P, St-Jean A *et al.* (2015) Overweight and obesity prevalence among school-aged Nunavik Inuit children according to three BMI classification systems. *J Adol Health* **57**, 31–36.
150. Zienczuk N & Egeland GM (2012) Association between socioeconomic status and overweight and obesity among Inuit adults: International Polar Year Inuit Health Survey, 2007–2008. *Int J Circumpolar Health* **71**, 1–7.
151. Zienczuk N, Young TK, Cao ZR *et al.* (2012) Dietary correlates of an at-risk BMI among Inuit adults in the Canadian high arctic: cross-sectional international polar year Inuit health survey, 2007–2008. *Nutr J* **11**, 73.
152. Kolahdooz F, Mathe N, Katunga LA *et al.* (2013) Smoking and dietary inadequacy among Inuvialuit women of child bearing age in the Northwest Territories, Canada. *Nutr J* **12**, 27.
153. Chateau-Degat M-L, Dewailly E, Noël M *et al.* (2010) Hypertension among the Inuit from Nunavik: should we expect an increase because of obesity? *Int J Circumpolar Health* **69**, 361–372.
154. Château-Degat M-L, Dewailly E, Charbonneau G *et al.* (2011) Obesity risks: towards an emerging Inuit pattern. *Int J Circumpolar Health* **70**, 166–177.
155. Ronn PF, Lucas M, Laouan Sidi EA *et al.* (2017) The obesity-associated risk of CVD and all-cause mortality is not lower in Inuit compared to Europeans: a cohort study of Greenlandic Inuit, Nunavik Inuit and Danes. *Atherosclerosis* **265**, 207–214.
156. Chateau-Degat ML, Dannenbaum DA, Egeland GM *et al.* (2011) A comparison of the metabolic response to abdominal obesity in two Canadian Inuit and First Nations population. *Obesity* **19**, 2254–2260.
157. Healey GK & Meadows LM (2007) Inuit women's health in Nunavut, Canada: a review of the literature. *Int J Circumpolar Health* **66**, 199–214.
158. Young TK, Bjerregaard P, Dewailly E *et al.* (2007) Prevalence of obesity and its metabolic correlates among the circumpolar Inuit in 3 countries. *Am J Public Health* **97**, 691–695.
159. Noel M, Dewailly E, Chateau-Degat ML *et al.* (2012) Cardiovascular risk factors and subclinical atherosclerosis among Nunavik Inuit. *Atherosclerosis* **221**, 558–564.
160. Erber E, Beck L, De Roose E *et al.* (2010) Prevalence and risk factors for self-reported chronic disease amongst Inuvialuit populations. *J Hum Nutr Diet* **23**, Suppl. 1, 43–50.
161. Galloway T, Blackett H, Chatwood S *et al.* (2012) Obesity studies in the circumpolar Inuit: a scoping review. *Int J Circumpolar Health* **71**, 18698–18698.
162. Public Health Agency of Canada (PHAC) (2013) Chronic Disease Infobase. http://66·240·150·17/cubes/intro-e.html (accessed March 2019).
163. Sefidbakht S, Johnson-Down L, Young TK *et al.* (2016) High protein and cholesterol intakes associated with emergence of glucose intolerance in a low-risk Canadian Inuit population. *Public Health Nutr* **19**, 1804–1811.
164. Hu XF, Singh K, Kenny T-A *et al.* (2019) Prevalence of heart attack and stroke and associated risk factors among Inuit in Canada: a comparison with the general Canadian population. *Int J Hyg Environ Health* **222**, 319–326.
165. Labonte ME, Dewailly E, Lucas M *et al.* (2014) Traditional dietary pattern is associated with elevated cholesterol among the Inuit of Nunavik. *J Acad Nutr Diet* **114**, 1208–1215.e1203.

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

166. Rudkowska I, Dewailly E, Hegele RA *et al.* (2013) Gene–diet interactions on plasma lipid levels in the Inuit population. *British J Nutr* **109**, 953–961.
167. Rudkowska I, Ouellette C, Dewailly E *et al.* (2013) Omega-3 fatty acids, polymorphisms and lipid related CVD risk factors in the Inuit population. *Nutr Metab* **10**, 26.
168. Chateau-Degat M, Ferland A, Déry S *et al.* (2012) Dietary sodium intake deleteriously affects blood pressure in a normotensive population. *Eur J Clin Nutr* **66**, 533–535.
169. Dewailly E, Blanchet C, Gingras S *et al.* (2003) Fish consumption and blood lipids in three ethnic groups of Quebec (Canada). *Lipids* **38**, 359–365.
170. Hu XF, Kenny TA & Chan HM (2018) Inuit country food diet pattern is associated with lower risk of CHD. *J Academ Nutr Diet* **118**, 1237–1248.e1231.
171. Messier V, Levesque B, Proulx JF *et al.* (2012) Seroprevalence of seven zoonotic infections in Nunavik, Quebec (Canada). *Zoonoses Public Health* **59**, 107–117.
172. Jenkins EJ, Castrodale LJ, de Rosemond SJ *et al.* (2013) Tradition and transition: parasitic zoonoses of people and animals in Alaska, northern Canada, and Greenland. *Adv Parasitol* **82**, 33–204.
173. Goyette S, Cao Z, Libman M *et al.* (2014) Seroprevalence of parasitic zoonoses and their relationship with social factors among the Canadian Inuit in Arctic regions. *Diagn Micr Infec Dis* **78**, 404–410.
174. McDonald JC, Gyorkos TW, Alberton B *et al.* (1990) An outbreak of toxoplasmosis in pregnant women in northern Quebec. *J Infect Dis* **161**, 769–774.
175. Messier V, Levesque B, Proulx JF *et al.* (2009) Seroprevalence of Toxoplasma gondii among Nunavik Inuit (Canada). *Zoonoses Public Health* **56**, 188–197.
176. Larrat S, Simard M, Lair S *et al.* (2012) From science to action and from action to science: the Nunavik Trichinellosis Prevention Program. *Int J Circumpolar Health* **71**, 18595.
177. Viallet J, MacLean JD, Goresky CA *et al.* (1986) Arctic trichinosis presenting as prolonged diarrhea. *Gastroenterology* **91**, 938–946.
178. Austin JW & Leclair D (2011) Botulism in the North: a disease without borders. *Clin Infect Dis* **52**, 593–594.
179. Bowmer FJ & Wilkinson DA (1976) Botulism in Canada, 1971–74. *Can Med Assoc J* **115**, 1084–1086.
180. Hauschild A & Gauvreau L (1985) Food-borne botulism in Canada, 1971–84. *Can Med Assoc J* **133**, 1141.
181. Harper SL, Edge VL, Ford J *et al.* (2015) Lived experience of acute gastrointestinal illness in Rigolet, Nunatsiavut: 'Just suffer through it'. *Soc Sci Med* **126**, 86–98.
182. Harper SL, Edge VL, Ford J *et al.* (2015) Acute gastrointestinal illness in two Inuit communities: burden of illness in Rigolet and Iqaluit, Canada. *Epidem Infect* **143**, 3048–3063.
183. Wright CJ, Sargeant JM, Edge VL *et al.* (2018) Water quality and health in northern Canada: stored drinking water and acute gastrointestinal illness in Labrador Inuit. *Environ Science Pollut Res Int* **25**, 32975–32987.
184. Richmond CAM & Ross NA (2009) The determinants of First Nation and Inuit health: a critical population health approach. *Health & Place* **15**, 403–411.
185. Gray AP, Richer F & Harper S (2016) Individual- and community-level determinants of Inuit youth mental wellness. *Can J Public Health* **107**, 251–257.
186. Fraser SL, Geoffroy D, Chachamovich E *et al.* (2015) Changing rates of suicide ideation and attempts among Inuit youth: a gender-based analysis of risk and protective factors. *Suicide Life Threat Behav* **45**, 141–156.
187. Durkalec A, Furgal C, Skinner MW *et al.* (2015) Climate change influences on environment as a determinant of Indigenous health: relationships to place, sea ice, and health in an Inuit community. *Soc Sci Med* **136–137**, 17–26.
188. Fournier B, Illasiak V, Kushner KE *et al.* (2019) The adoption, implementation and maintenance of a school food policy in the Canadian Arctic: a retrospective case study. *Health Promot Int* **34**, 902–911.
189. Statistics Canada (2015) Measured BMI, Canadian Community Health Survey – Nutrition, 2015. https://www150.statcan.gc.ca/n1/daily-quotidien/170801/dq170801a-eng.htm (accessed March 2019).
190. Rodd C & Sharma AK (2016) Recent trends in the prevalence of overweight and obesity among Canadian children. *Can Med Assoc J* **188**, E313–E320.
191. Public Health Agency of Canada (PHAC) (2017) Diabetes in Canada. https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/diseases-conditions/diabetes-canada-highlights-chronic-disease-surveillance-system/diabetes-in-canada-eng.pdf (accessed March 2019).
192. Padwal RS, Bienek A, McAlister FA *et al.* (2016) Epidemiology of hypertension in Canada: an update. *Can J Cardiol* **32**, 687–694.
193. Statistics Canada (2015) Cholesterol levels of adults, 2012–2013. https://www150.statcan.gc.ca/n1/pub/82–625-x/2014001/article/14122-eng.htm (accessed March 2019).
194. Nutrition North Canada (NNC) (2019) How Nutrition North Canada Works. http://www.nutritionnorthcanada.gc.ca/eng/1415385762263/1415385790537 (accessed March 2019).
195. Burnett K, Skinner K & LeBlanc J (2015) From Food Mail to Nutrition North Canada: reconsidering federal food subsidy programs for northern Ontario. *Can Food Stud* **2**, 141–156.
196. Galloway T (2017) Canada's northern food subsidy Nutrition North Canada: a comprehensive program evaluation. *Int J Circumpolar Health* **76**, 1279451.
197. Niqittiavak Committee (2013) The Nutrition North Canada Program. http://www.nunavutfoodsecurity.ca/node/793 (accessed March 2019).
198. Food Secure Canada (FSC) (2016) The Right to Food Affordable Accessible Food in Northern Canada. https://foodsecurecanada.org/sites/foodsecurecanada.org/files/food_in_the_north.pdf (accessed March 2019).
199. Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) (2018) Government of Canada announces improvements to Nutrition North Canada, including support for country food. https://www.newswire.ca/news-releases/government-of-canada-announces-improvements-to-nutrition-north-canada-including-support-for-country-food-702377851.html (accessed March 2019).
200. Dewailly E, Ayotte P, Blanchet C *et al.* (1996) Weighing contaminant risks and nutrient benefits of country food in Nunavik. *Arctic Med Res* **55**, 13–19.
201. Kinloch D, Kuhnlein H & Muir D (1992) Inuit foods and diet: a preliminary assessment of benefits and risks. *Sci Total Environ* **122**, 247–278.
202. Inuit Tapiriit Kanatami (ITK) (2014) Social Determinants of Inuit Health in Canada. https://www.itk.ca/wp-content/uploads/2016/07/FoodSecurity_FactSheet.pdf (accessed March 2019).
203. Boyd AD & Furgal CM (2018) Communicating environmental health risks with indigenous populations: a systematic literature review of current research and recommendations for future studies. *Health Commun* **34**, 1564–1574.
204. Krü mmel E-M & Gilman A (2016) An update on risk communication in the Arctic. *Int J Circumpolar Health* **75**, 33822–33822.
205. Action Canada (2014) Hunger in Nunavut: local food for healthier communities. http://www.actioncanada.ca/wp-content/uploads/2014/04/TF-3-Hunger-in-Nunavut-EN.pdf (accessed March 2019).
206. Binnington MJ, Curren MS, Chan HM *et al.* (2016) Balancing the benefits and costs of traditional food substitution by

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press

indigenous Arctic women of childbearing age: impacts on persistent organic pollutant, mercury, and nutrient intakes. *Environ Int* **94**, 554–566.
207. Gmelch L, Hintelmann H, Hickie B *et al.* (2017) Risk-benefit assessment of monomethylmercury and omega-3 fatty acid intake for ringed seal consumption with particular emphasis on vulnerable populations in the Western Canadian Arctic. *Front Nutr* **4**, 30.
208. Alkazemi D, Egeland GM, Roberts LJ *et al.* (2013) New insights regarding tissue Se and Hg interactions on oxidative stress from plasma IsoP and IsoF measures in the Canadian Inuit population. *J Lipid Res* **54**, 1972–1979.
209. Turgeon O'Brien H, Gagné D, Vaissière É *et al.* (2014) Effect of dietary calcium intake on lead exposure in Inuit children attending childcare centres in Nunavik. *Int J Environ Health Res* **24**, 482–495.
210. McIntyre L (2003) Food security: more than a determinant of health. *Policy Options Montreal* **24**, 46–51.
211. Skinner K, Burnett K, Williams P *et al.* (2016) Challenges in assessing food environments in northern and remote communities in Canada. *Can J Public Health* **107**, 60–63.
212. Adlard B, Donaldson S, Odland J *et al.* (2018) Future directions for monitoring and human health research for the Arctic Monitoring and Assessment Programme. *Glob Health Action* **11**, 1480084.
213. Qikiqtani Inuit Association (QIA) (2019) Food sovereignty and harvesting. https://www.qia.ca/wp-content/uploads/2019/03/Food-Sovereignty-and-Harvesting.pdf (accessed February 2020).
214. Inuit Tapiriit Kanatami (ITK) (2017). An Inuit-specific approach for the Canadian food policy. https://www.itk.ca/wp-content/uploads/2019/01/ITK_Food-Policy-Report.pdf (accessed February 2020).
215. Grant MJ & Booth A (2009) A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J* **26**, 91–108.

https://doi.org/10.1017/S1368980020002402 Published online by Cambridge University Press