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Traditional food consumption is associated with better diet quality and adequacy among Inuit adults in Nunavut, Canada

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Abstract

The Inuit population is undergoing a rapid nutrition transition as a result of reduced consumption of traditional foods. This study aims to describe the differences in dietary adequacy between non-traditional and traditional eaters among Inuit populations in Nunavut, Canada. A cross-sectional survey was conducted using a culturally appropriate quantitative food frequency questionnaire. Participants included 208 Inuit adults from three isolated communities in Nunavut. Traditional eaters consumed a more nutrient-dense diet and achieved better dietary adequacy than non-traditional eaters. Traditional foods accounted for 7 and 27% of energy intake among non-traditional and traditional eaters, respectively. Non-nutrient-dense foods accounted for a greater proportion of energy intake in non-traditional eaters; however, these were consumed in significant amounts by both the groups (36 and 27% of total energy). Consumption of traditional foods is associated with greater diet quality and dietary adequacy. Efforts should be made to promote traditional and non-traditional foods of high-nutritional quality.

Keywords

Aboriginal populations, nutrient density, nutrition transition, traditional eaters

History

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Introduction

Inuit are an Aboriginal population inhabiting the Arctic and sub-Arctic regions of North America, Greenland and Siberia. Present in these regions long before the arrival of European settlers, Inuit established a distinct and unique culture based on living off resources from the land, sea and sky. In the 1950s, Inuit of Canada moved from a nomadic, hunter-gatherer lifestyle to a stationary community existence and, since then, have been undergoing significant socio-cultural shifts linked to exposure to southern lifestyles, expanding globalization and modern schooling policies (Condon et al., 1995; Kuhnlein & Receveur, 2007; Kuhnlein et al., 2001; Sharma, 2010; Vorobieva & Sutyrin, 2005).

Dietary transition is a consequence of lifestyle changes in the Arctic. Prior to settlement into permanent communities, Inuit were self-sufficient and utilized a food system derived entirely from local food resources. The traditional diet, comprising a diverse range of species including sea and land mammals, fish, shellfish, birds and plants, has been widely recognized as nutrient-rich and has offered these populations protection from a variety of chronic diseases (Adler et al., 1994; Condon et al., 1995; Dewailly et al., 2001; Kuhnlein, 1995; Kuhnlein & Receveur, 2007; Kuhnlein et al., 2001, 2002, 2008; Pauktuutit Inuit Women of Canada, 2006; Sharma, 2010; Vorobieva & Sutyrin, 2005). However, traditional foods are being replaced in the diet by imported, processed foods high in fat and sugar and of relatively low-nutritional quality (Duhaime et al., 2002; Kuhnlein & Receveur, 1996, 2007; Kuhnlein et al., 2004; Sharma et al., 2010; Wein, 1995; Wein et al., 1996).

This rapid dietary change presents a public health concern for Inuit as worsening diet quality (Berti et al., 1999; Kuhnlein & Receveur, 1996; Kuhnlein et al., 2004; Lawn & Harvey, 2001) and an increasingly sedentary lifestyle, which are associated with growing risk for chronic diseases such as coronary heart disease, hypertension, type II diabetes mellitus and cancers (Bjerregaard et al., 2004; Deering et al., 2009; Gaziano, 2010; Jorgensen et al., 2002; Kuhnlein & Receveur, 1996; Kuhnlein et al., 2004; Popkin, 2011; Young, 2007). Recent research in Nunavut, a self-governed Inuit territory in Canada, has suggested that the population largely consumes a diet high in fat, carbohydrate and sugar, yet insufficient with regard to a number of important nutrients including vitamins A and D, folate, and fibre (Hopping et al., 2010c; Kuhnlein & Receveur, 1996). According to Statistics Canada, approximately 64% of the population in Nunavut is classified as overweight or obese (Statistics Canada, 2012). A recent study in three remote Nunavut communities found that 72% of Inuit adults were overweight or obese (Hopping et al., 2010a). The direct implications of these rapid dietary changes on the Inuit population may affect their quality of life (Health Canada, 2012) and further lower life expectancy, which at present is more than 12 years below that of the average Canadian non-Aboriginal (Wilkins et al., 2008).

Modern food practices are displacing traditional food practices more rapidly among some Inuit individuals and communities than others, with increased reliance on processed foods imported from

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the south (Counil et al., 2008; Mead et al., 2010; Sharma et al., 2010). Data suggest that, in some northern populations, dietary adequacy varies among individuals that consume different amounts of traditional foods (Batal et al., 2005; Kuhnlein & Receveur, 2007); however, little is known about the nutritional benefits of the traditional diet of Inuit in Nunavut. The objective of the present study was to assess nutrient density, dietary adequacy, and main food sources of energy and nutrient intake among traditional and non-traditional food eaters in Nunavut, Canada. Such data are necessary to inform the development of an intervention program to improve dietary adequacy.

Methods

Setting

Nunavut is the easternmost of three territories in Arctic Canada. Of the territory's population of approximately 33,000, 85% self-identified as Inuit. Local languages are Inuktitut and Inuinnaqtun. With a median age of 24 years, Nunavut has the youngest population of any province or territory in Canada.

Three communities located in the Kitikmeot region of Nunavut were identified by the Government of Nunavut to represent varying levels of Inuit population and socioeconomic status. These community populations have been previously described (Sharma, 2010), but in brief, range from 800 to 1500 people, 80–90% of whom self-identified as Inuit. The employment rate is 55%, and the gross domestic product (GDP) 2010 growth rate was 11.4% (Nunavut Bureau of Statistics, 2011). One community is a regional centre with a larger non-Aboriginal population and greater engagement in the wage economy than the other two. Like many Nunavut communities, each participating community has two food stores that obtain food primarily through shipments from the south via airplane year-round and via barge/sealift once per year when the ice melts. Food is also obtained, to varying degrees, by traditional means (e.g. hunting, food sharing networks).

Data collection

Sample size and data collection have previously been described elsewhere (Sharma, 2010). A minimum sample size of 150 individuals (50 per community) was computed to explore the minimum detectable difference between pre- and post-intervention for calories from fat, total sugar and total dietary fibre intake. Study participants were randomly selected using up-to-date community housing maps. This method ensured sampling from areas with varied proximities to food stores and land resources. One eligible resident per household was selected, which was the first resident we came in contact with in the home. In homes where there was more than one eligible resident, we chose only the first contact. We excluded residents <19 years (children) and pregnant/lactating women due to their different nutritional requirements and possible changes in dietary habits. If an eligible participant was not available upon the first visit, interviewers repeatedly visited the household at different times of the day up to seven times for recruitment, after which the house was marked as unavailable, in which case another house closest to the intended house was selected. Study participants were familiarized with the purpose of the study and assessment instruments, and upon agreeing to participate, a signed consent form (available in English and local languages) was obtained. Response rates in the three communities were 69–93%.

Dietary data were collected between June and October 2008 using a culturally appropriate quantitative food frequency questionnaire (QFFQ) developed specifically for Inuit in these communities (Sharma et al., 2010). A 150-item QFFQ was designed to capture all food/beverages consumed and included 12 breads and cereals; 64 meat, fish and poultry; 13 dairy; 13 fruit; 19 vegetables; 14 desserts and snacks; 12 beverages; and 3 alcohol. Of these items, 39 were traditional foods not available in stores, and also included were foods that vary in availability throughout the seasons. Traditional meats/poultry include caribou, seal, muskox, goose and ptarmigan. Traditional fish includes Arctic char and trout (Sharma et al., 2010). The QFFQ was previously validated against repeated 24-h recalls collected in the same population, and the two methods showed a good agreement proportion (same or adjacent quartiles) of 83% for energy, 94% for sugar, 83% for macronutrients and 77% for micronutrients, indicating that the QFFQ was a valid tool to assess diet in this population (Pakseresht & Sharma, 2010).

Data were collected by community health staff trained by the Principal Investigator in administration of the questionnaires according to a manual of procedures. Participants were asked to report the frequency of consumption of each item on the QFFQ over the prior 30-day period choosing from eight categories which ranged from ''never'' to ''two or more times per day.'' Three-dimensional food models (NASCO Company, 901 Jamesville Ave, Fort Atkinson, Wisconsin 53538), household units (e.g. bowls, spoons), standard units (e.g. cups) and local food packages were carefully chosen with input from community members to best estimate the average portion sizes of all food items. Nutrient intake was calculated per person using Nutribase Clinical Nutrition Manager version 9 (Cybersoft Inc., Phoenix, AZ), a computerized dietary database based on the US Department of Agriculture (USDA) National Nutrient Database for Standard Reference, which multiplies the nutrient content by the amount in grams consumed by the frequency of consumption per day. For participants whose primary language was not English, either an interviewer fluent in the local language conducted the survey or an interpreter was used. Interviewers/interpreters were trained by the investigators to ensure standardization. Staff interviewed participants in their homes, and the majority of interviews were conducted in Inuktitut and recorded in English.

Institutional Review Board approval was obtained from the Committee on Human Studies at the University of Hawaii and the Office of Human Research Ethics at the University of North Carolina at Chapel Hill. The Nunavut Research Institute licensed the study. Participants were remunerated for their time with C$25 gift cards from local stores.

Data analysis

Data were analyzed using SAS statistical software, version 9.2 (SAS Institute, Inc., Cary, NC). The mean, standard deviation, and median of daily energy and nutrient intake were calculated for all participants. Participants who reported extreme energy intake (<500 kcal or >5000 kcal, $n = 3$) were excluded from the analysis. Traditional and non-traditional eaters were classified as those consuming more and less than 300 g of traditional food daily, based on the median intake in the entire population.

To compare diet quality of traditional eaters to non-traditional eaters, nutrient densities per 1000 kcal were determined by dividing each participant's daily nutrient intake by their energy intake (kcal), multiplied by 1000. Nutrient densities were not normally distributed after log transformation; therefore, the non-parametric Wilcoxon rank-sum test was used to determine statistically significant differences in nutrient densities between traditional and non-traditional eaters. All analyses were stratified by traditional food intake status. All tests and p values were two-sided and considered statistically significant at $\alpha = 0.05$.

Dietary adequacy of traditional and non-traditional eaters was assessed using Dietary Reference Intakes (DRI) for gender-specific age groups 19–30, 31–50, 51–70 and >70 years (Institute

Table 1. Mean and standard deviation (SD) energy and selected nutrient intake among Inuit men and women by traditional food consumption status.

	Women					Men				
	Non-traditional eaters ($n=69$)		Traditional eaters ($n=103$)			Non-traditional eaters ($n=18$)		Traditional eaters ($n=18$)		
	Mean	SD	Mean	SD	DRI[a]	Mean	SD	Mean	SD	DRI[a]
Age (years)	42.5	14.1	42.4	12.7	–	37.8	14.7	46.3	14.5	–
Energy (kcal)	2260	1123	3114	1225	1800[b]	3199	1426	4054	1419	2200[b]
% energy from protein	18.4	6.4	27.2	7.1	10–35[c]	17.2	4.3	26.1	6.1	10–35[c]
% energy from CHO	51.0	9.7	43.7	8.4	45–65[c]	50.4	9.7	42.5	7.5	45–65[c]
% energy from fat	28.9	6.1	28.1	4.0	20–35[c]	31.6	6.3	29.7	3.9	20–35[c]
Protein (g)	96.8	40.8	207.3	98.7	–	139.6	84.0	251.0	62.8	–
CHO (g)	297.7	189.9	344.3	153.2	–	400.0	175.0	442.5	200.7	–
Sugars (g)	163.1	147.0	159.7	153.2	<25% of energy[a]	208.3	130.8	221.2	140.1	<25% of nergy[a]
Dietary fibre (g)	11.2	5.6	15.2	6.9	25[d]	16.9	9.3	19.4	8.0	38[d]
Fat (g)	71.4	35.2	97.5	41.4	–	114.5	67.2	134.0	47.6	–
Saturated fat (g)	26.4	14.2	33.0	14.6	<10% of energy[e]	41.1	25.5	45.8	18.0	<10% of energy[e]
Monounsaturated fat (g)	24.5	12.0	33.7	14.2	–	40.3	23.8	47.3	16.9	–
Polyunsaturated fat (g)	10.4	5.0	15.3	6.5	–	16.4	9.0	21.0	7.8	–
Omega-3 fatty acid (g)	0.9	0.5	2.1	1.3	–	1.1	0.6	3.0	1.2	–
Omega-6 fatty acid (g)	8.1	4.5	10.6	5.2	–	13.2	8.3	15.4	7.0	–
Cholesterol (mg)	298.0	162.0	592.0	375.0	As low as possible	498.0	399.0	806.0	357.0	As low as possible
Vitamin A (μg-RAE)[f]	667.0	683.0	1342	1764	700[g]	640.0	267.0	1097	621	900[g]
Thiamin (mg)	1.6	0.6	2.6	1.0	1.1[g]	2.2	0.9	3.3	0.9	1.2[g]
Riboflavin (mg)	2.7	1.1	4.7	2.2	1.1[g]	3.5	1.5	6.0	1.9	1.3[g]
Niacin (mg)	23.3	9.8	41.7	17.4	14[g]	35.5	23.0	59.5	21.7	16[g]
Pantothenic acid (mg)	6.4	2.9	11.5	6.3	5[d]	8.4	4.2	14.6	4.7	5[d]
Vitamin B-6 (mg)	1.5	0.7	2.3	1.0	1.3[g]	2.3	1.5	3.2	1.2	1.3[g]
Total folate (μg DFE)[h]	266.5	115.8	353.7	133.3	400[g]	128.2	128.2	450.4	134.1	400[g]
Vitamin B-12 (μg)	6.7	4.2	23.1	15.9	2.4[g]	9.3	4.5	24.8	12.5	2.4[g]
Iron (mg)	16.7	7.2	35.6	17.3	18[g]	23.1	7.9	40.3	10.8	8[g]
Vitamin C (mg)	168.6	122.3	193.0	137.7	75[g]	183.3	124.5	229.8	194.5	90[g]
Vitamin D (μg)[i]	3.8	2.5	5.8	5.4	5[d]	5.6	3.3	9.2	7.8	5[d]
Vitamin E (mg)[j]	3.2	1.9	4.5	2.7	15[g]	4.4	2.2	6.2	2.9	15[g]
Calcium (mg)	995.0	630.0	1188	646	1000[d]	1159	505	1392	802	1000[d]
Magnesium (mg)	274.9	101.9	434.0	157.6	320[g]	358.1	160.2	537.2	129.4	420[g]
Potassium (g)	3.0	1.2	4.8	1.9	4.7[d]	3.8	1.8	6.0	1.7	4.7[d]
Sodium (g)	3.0	1.7	4.6	2.3	1.5[d]	4.6	2.3	5.6	1.9	1.5[d]
Selenium (μg)	100.0	48.4	215.1	224.3	55[g]	134.0	83.5	226.6	78.1	55[g]
Zinc (mg)	12.0	5.6	25.3	13.9	8[g]	17.2	8.0	28.5	8.5	11[g]

[a]The dietary reference intakes (DRI) are presented in this table using adequate intake (AI), recommended dietary allowance (RDA) for men and women aged 31–50 years, acceptable macronutrient distribution ranges (AMDR) and recommendation on saturated fat intake by Joint WHO/FAO (Institute of Medicine of the National Academies, 2005; Joint WHO/FAO Expert Consultation, 2003).
[b]Estimated amounts of calories needed to maintain energy balance for men and women aged between 31 and 50 years at the level of very low physical activity-sedentary level.
[c]Acceptable macronutrient distribution ranges (AMDR).
[d]Adequate intake (AI).
[e]Recommendation on saturated fat intake by Joint WHO/FAO.
[f]Retinol activity equivalent.
[g]Recommended dietary allowance (RDA).
[h]Dietary folate equivalents.
[i]As cholecalciferol.
[j]As α-tocopherol.

of Medicine of the National Academies, 2005). Intakes were compared to estimated average requirements (EARs) for specific nutrients. If the EAR was not available, as for dietary fibre, vitamin D, pantothenic acid, potassium, sodium and calcium, the adequate intake (AI) was used instead.

Results

Participants were 208 Inuit adults. The overall mean $\pm$ SD quantity of traditional foods consumed per day was 418 ± 342 g. Table 1 presents energy and selected nutrient intake among Inuit men and women classified as traditional or non-traditional eaters. For all men and women, mean vitamin E and dietary fibre intakes were below the DRIs. For men and women non-traditional eaters, mean intakes of vitamin A, magnesium and potassium were below the respective DRIs. For women non-traditional eaters only, mean vitamin D, iron and calcium intakes were also below the DRIs. Mean folate was below the DRI for all participants except for men traditional eaters.

Table 2 presents the nutrient density of the diet (per 1000 kcal) of the traditional and non-traditional eaters. The diet of traditional eaters contained a higher density of protein, omega-3 fatty acids, riboflavin, niacin, pantothenic acid, vitamin B-12, iron, magnesium, potassium, selenium, zinc ($p \leq 0.0001$), thiamin ($p \leq 0.001$) and vitamin A ($p \leq 0.05$), as well as a more favourable omega 6:3 ratio than that of non-traditional eaters (5:1 versus 10:1). It also contained more cholesterol ($p \leq 0.0001$). For non-traditional eaters, 1000 kcal of food consumed contained a greater density

Table 2. Mean and standard deviation (SD) nutrient density per 1000 kcal of selected nutrients among Inuit traditional versus non-traditional eaters.

	Non-traditional eaters ($n=87$)		Traditional eaters ($n=121$)	
	Mean	SD	Mean	SD
Protein (g)	45.3*	15.1	67.5*	17.4
Carbohydrate (g)	127.1*	24.2	108.8*	20.6
Sugars (g)	66.2*	28.0	50.0*	19.1
Dietary fibre (g)	5.2	1.8	4.9	1.6
Fat (g)	32.7	6.9	31.5	4.5
Saturated fat (g)	11.9***	3.4	10.6***	1.8
Monounsaturated fat (g)	11.4	2.8	11.0	2.0
Polyunsaturated fat (g)	4.8	1.5	5.0	1.1
Omega-3 fatty acid (g)	0.4*	0.2	0.7*	0.4
Omega-6 fatty acid (g)	3.8	1.5	3.4	1.1
Cholesterol (mg)	144.9*	72.1	201.1*	121.3
Vitamin A (μg-RAE)[a]	301.7***	404.6	434.2***	588.1
Thiamin (mg)	0.8**	0.3	0.9**	0.2
Riboflavin (mg)	1.3*	0.4	1.6*	0.6
Niacin (mg)	11.0*	3.3	14.2*	4.6
Pantothenic acid (mg)	3.0*	1.3	3.8*	1.5
Vitamin B-6 (mg)	0.7	0.2	0.8	0.2
Total folate (μg DFE)[b]	148.8	46.0	144.8	47.1
Vitamin B-12 (μg)	3.3*	2.3	7.7*	4.9
Iron (mg)	8.0*	3.4	11.5*	3.7
Vitamin C (mg)	71.3	46.5	59.2	35.3
Vitamin D (μg)[c]	1.8	1.2	2.0	1.7
Vitamin E (mg)[d]	1.5	0.6	1.5	0.6
Calcium (mg)	436.6***	227.0	375.6***	148.6
Magnesium (mg)	127.5*	36.2	143.2*	26.7
Potassium (g)	1.4*	0.4	1.6*	0.4
Sodium (g)	1.4	0.3	1.5	0.4
Selenium (μg)	46.6*	21.9	67.7*	42.9
Zinc (mg)	5.7*	2.2	8.1*	2.4

[a]Retinol activity equivalent.
[b]Dietary folate equivalents.
[c]As cholecalciferol.
[d]As α-tocopherol.
*Significantly different, $p \leq 0.0001$.
**Significantly different, $p \leq 0.001$.
***Significantly different, $p \leq 0.05$.

of carbohydrate, sugar ($p \leq 0.0001$), saturated fat and calcium ($p \leq 0.05$).

Table 3 presents the percentage of participants, grouped by traditional and non-traditional eaters that did not meet selected nutrient DRIs for their respective age group and gender. For all nutrients examined, a greater percentage of non-traditional eaters were below the EAR/AI than traditional eaters. These differences were substantial (more than a 10% point difference) for folate, vitamins A, B-6 and D, zinc, pantothenic acid, magnesium and potassium. In both the groups, dietary fibre, calcium, potassium, and vitamins D and E were below recommended levels in more than 45% of participants.

Top food sources of energy and selected nutrient intakes for traditional and non-traditional eaters (Table 4) are presented. Among traditional eaters, non-nutrient-dense foods were the single largest contributors to energy intake (27%). These were foods that had a high fat or energy content and/or a relatively low-nutrient density and that were not considered traditional foods or classified in other food groups; the category included such foods as soft drinks, cookies, potato chips and non-dairy coffee whitener. The contribution of non-nutrient-dense foods to total energy intake was matched by the combined contributions of traditional land and sea foods (27%). Also among traditional eaters, traditional foods accounted for 65% of protein intake and 58% of iron intake. As seen in Table 4, among non-traditional

Table 3. Percentage of Inuit traditional and non-traditional eaters below the dietary reference intakes (Institute of Medicine, 2005).

Nutrients	Non-traditional eaters ($n=87$)	Traditional eaters ($n=121$)
Dietary fibre[a]	97.7	90.9
Calcium[a]	56.3	46.3
Total folate[c] (μg DFE)[b]	49.4	21.5
Vitamin A[c] (RAE)[d]	43.7	14.9
Vitamin B-6[c]	31.0	5.0
Vitamin C[c]	19.5	14.9
Vitamin D[e]	73.6	59.5
Vitamin E[f]	100.0	99.2
Iron[c]	9.2	0.0
Zinc[c]	18.4	0.8
Thiamin[c]	10.3	0.8
Riboflavin[c]	0.0	0.0
Niacin[c]	4.6	0.0
Pantothenic acid[a]	35.6	7.4
Vitamin B-12[c]	4.6	0.0
Magnesium[c]	52.9	9.1
Potassium[a]	83.9	53.7
Sodium[a]	9.2	1.7
Selenium[c]	0.0	0.0

[a]Adequate Intake (AI) used for comparison.
[b]Dietary folate equivalent.
[c]Estimated average requirement (EAR) used for comparison.
[d]Retinol activity equivalent.
[e]As cholecalciferol in the absence of adequate exposure to sunlight.
[f]As α-tocopherol.

eaters, traditional foods contributed much less to energy intake (7%), while non-nutrient-dense foods were still main contributors (36%), followed by beef, pork and dairy (22%). Traditional foods still accounted for a significant portion of iron and protein intakes (23 and 27%, respectively), as did non-traditional meats (beef and pork; 13 and 24%, respectively). In both traditional and non-traditional groups, white breads were notable contributors to iron, calcium and fibre, and non-nutrient-dense foods were main contributors to fat, carbohydrate and sugar intakes.

Discussion

The present study confirms consumption of traditional foods among Inuit in Nunavut was associated with greater nutrient density, specifically with regard to protein and a number of vitamins and minerals including vitamin A, several B-vitamins, iron, zinc, magnesium, potassium, sodium and selenium. It adds to the growing body of evidence that the transitioning Inuit diet is associated with decreasing diet quality (Duhaime et al., 2002; Kuhnlein & Receveur, 1996, 2007; Kuhnlein et al., 2004; Sharma et al., 2010; Simopoulos, 2008; Wein, 1995; Wein et al., 1996). It was also associated with a more favourable omega 6:3 fatty acid ratio and lower density of carbohydrate, saturated fat and sugar. Consistent with these findings, more traditional foods in the diet translated into greater dietary adequacy for all nutrients examined. However, many participants regardless of whether traditional or non-traditional eaters, consumed low amounts of dietary fibre, vitamins E and D, calcium and potassium. Low levels of these nutrients in the diet could have a number of undesirable health consequences for Inuit, including increased risk of constipation, diverticular disease and type-2 diabetes (fibre), and decreased immune function and calcium absorption (vitamin D) (Report of the Joint WHO/FAO Expert Consultation, 2003).

Recent research identified that few Inuit families, if any, exclusively follow a traditional diet, and therefore store-bought foods are now a major component of the food environment in Nunavut (Hopping et al., 2010c; Mead et al., 2010). This was

Table 4. Percentage of energy and selected nutrient contributions of the top 10 food sources among Inuit traditional and non-traditional eaters.

Inuit traditional eaters

Foods	Energy	Foods	Protein	Foods	Fat	Foods	CHO
NNDF	27.2	Traditional land foods	38.2	NNDF	20.5	NNDF	47.8
Traditional land foods	15.5	Traditional sea foods	26.8	Beef and pork	19.6	White breads	11.4
Traditional sea foods	11.7	Beef and pork	9.9	Traditional sea foods	13.0	Fruits	7.4
Beef and pork	9.4	Dairy	5.2	Traditional land foods	11.2	Noodles	6.2
White breads	7.7	Chicken/turkey	4.6	Dairy	9.9	Rice	3.4
Dairy	5.8	NNDF	3.4	White breads	6.6	Dairy	3.4
Noodles	5.0	White breads	2.8	Noodles	5.4	Cereals	3.3
Fruits	3.1	Noodles	2.6	Chicken/turkey	4.2	Traditional land foods	3.1
Chicken/turkey	2.7	Other starches	1.0	Nuts	3.0	Beef and pork	2.5
Cereals	1.7	Soups and stews	0.8	Other starches	2.2	Vegetables	2.4
Total	89.8		95.3		95.6		90.9

Foods	Sugar	Foods	Fibre	Foods	Calcium	Foods	Iron
NNDF	72.4	Fruits	17.3	White breads	27.7	Traditional land foods	46.3
Fruits	11.7	NNDF	14.1	Dairy	27.3	Traditional sea foods	11.6
Dairy	6.2	White breads	11.4	NNDF	18.7	White breads	8.4
Wheat breads	1.9	Vegetables	9.8	Noodles	4.9	NNDF	7.5
Vegetables	1.5	Traditional land foods	7.3	Traditional sea foods	4.8	Beef and pork	5.7
Cereals	1.3	Wheat breads	7.0	Traditional land foods	3.2	Cereals	5.1
White breads	1.1	Noodles	6.4	Beef and pork	2.1	Noodles	3.6
Beef and pork	1.0	Cereals	6.2	Other starches	2.1	Dairy	1.9
Noodles	1.0	Beef and pork	6.0	Fruits	1.8	Vegetables	1.5
Traditional land foods	0.5	Potatoes	3.1	Vegetables	1.8	Wheat breads	1.4
Total	98.6		88.6		94.4		93.0

Inuit non-traditional eaters

Foods	Energy	Foods	Protein	Foods	Fat	Foods	CHO
NNDF	35.5	Beef and pork	24.2	Beef and pork	28.9	NNDF	53.5
Beef and pork	14.0	Traditional land foods	15.9	NNDF	24.2	White breads	9.6
Dairy	8.2	Dairy	11.4	Dairy	13.3	Fruits	7.9
White breads	7.5	Chicken/turkey	11.3	Chicken/turkey	6.1	Noodles	5.5
Noodles	5.3	Traditional sea foods	11.3	Noodles	5.8	Cereals	4.5
Chicken/turkey	4.1	NNDF	6.4	White breads	5.6	Dairy	4.2
Traditional land foods	4.1	White breads	4.5	Traditional sea foods	4.0	Rice	2.5
Fruits	4.0	Noodles	4.2	Traditional land foods	2.8	Beef and pork	2.4
Traditional sea foods	3.3	Other starches	1.9	Other starches	2.6	Wheat breads	2.1
Cereals	2.8	Cereals	1.6	Nuts	2.5	Vegetables	1.9
Total	88.8		92.7		95.8		94.1

Foods	Sugar	Foods	Fibre	Foods	Calcium	Foods	Iron
NNDF	74.5	Fruits	19.6	Dairy	37.9	Traditional land foods	18.5
Fruits	10.9	NNDF	17.2	NNDF	22.2	NNDF	13.2
Dairy	6.5	White breads	11.3	White breads	19.3	White breads	13.0
Cereals	2.0	Cereals	9.0	Noodles	4.4	Beef and pork	12.9
Wheat breads	1.7	Vegetables	8.1	Beef and pork	2.7	Cereals	12.7
White breads	1.0	Wheat breads	8.0	Other starches	2.2	Noodles	6.0
Beef and pork	0.9	Beef and pork	6.6	Cereals	1.9	Traditional sea foods	4.7
Vegetables	0.9	Noodles	6.6	Fruits	1.9	Dairy	2.9
Noodles	0.7	Other starches	2.9	Vegetables	1.7	Chicken/turkey	2.8
Potatoes	0.3	Potatoes	2.6	Traditional sea foods	1.0	Wheat breads	2.6
Total	99.4		91.9		95.2		89.3

NNDF non-nutrient dense foods; *CHO* carbohydrate.

evident in the present study, as store-bought foods contributed much of the dietary intake of both traditional and non-traditional eaters. Non-nutrient-dense foods constituted the greatest source of energy in both the groups, although more so among non-traditional compared to traditional eaters. While non-nutrient-dense foods are often high in energy, much of the calories are derived from fat and/or sugar and many essential nutrients may be lacking. Therefore, higher consumption of these foods may be associated with the greater dietary inadequacy observed among non-traditional eaters. Even though traditional foods contributed very little to energy intake of non-traditional eaters, they were still important sources of protein and iron, attesting to their importance in diet quality. Overall, these findings are in agreement with those from a similar study among Aboriginal peoples of the Canadian Arctic, which found that on days when no traditional foods were consumed, participants had a significantly higher percentage of their energy intake as carbohydrate, fat and sucrose, suggesting lower dietary quality (Kuhnlein et al., 2004).

Other studies have observed age disparities with regard to traditional and non-traditional food consumption in other Arctic populations (Bersamin et al., 2006). A previous study of this same population (Hopping et al., 2010b) also observed a greater frequency of traditional food consumption among older individuals. In the present assessment, however, age-related differences among those classified as traditional and non-traditional eaters were not observed.

The dietary inadequacies observed in this study suggest a need for dietary improvement among Inuit in Nunavut, particularly among those who tend to follow non-traditional eating patterns. Nutrition education and behaviour change interventions are often effective strategies used to improve diet at the community level (Ammerman et al., 2002; Goodman et al., 2006; Report of the Joint WHO/FAO Expert Consultation, 2003). The fact that nutrient inadequacies were also observed among many subjects who were classified as traditional eaters suggests that entire communities could benefit from such intervention strategies. The promotion of traditional foods would be an important component of any nutritional intervention. In addition to the contributions, these foods make to diet quality and dietary adequacy, as shown in this study, they also promote physical activity through hunting, fishing and other procurement activities (Redwood et al., 2008). Furthermore, preservation of traditional dietary practices would be expected to promote both individual and community identity and well-being, as the use of these foods is deeply rooted in Inuit cultural expression (Willows, 2005).

Although the Inuit traditional diet plays a large role in maintaining Inuit health and cultural identity, the dietary transition is a result of multiple influences of economic, societal, individual and environmental nature (Arctic Climate Impact Assessment, 2004). For example, much of the communities' populations are low-income. Traditional food procurement activities, such as hunting, have evolved to include the use of motorized vehicles, firearms, etc., which has increased the costs associated with these activities (Pauktuutit Inuit Women of Canada, 2006). Attending school and engagement in the wage economy also limits availability to engage in traditional activities (Pauktuutit Inuit Women of Canada, 2006). Further, anthropogenic effects, such as climate change and environmental contamination, may impact the availability and quality of the traditional food supply (Arctic Climate Impact Assessment, 2004; Guyot et al., 2006; O'Neil et al., 1997). Intervention strategies should therefore extend beyond the promotion of traditional foods and also encourage the use of healthier food options available in local food stores, such as fruit and vegetables and other products low in energy but high in vitamins and minerals. However, cost and availability also affect market food choice. Perishable food items, such as fruit and vegetables, are not obtained locally and are shipped in from other regions, significantly elevating prices and affecting quality (Redwood et al., 2008). Options that are the most affordable and the most resistant to spoilage are heavily processed items (Pauktuutit Inuit Women of Canada, 2006), including those described in this study as non-nutrient-dense foods. It is therefore imperative that interventions integrate creative and culturally appropriate strategies in order to assist individuals and families of Arctic communities in overcoming the range of barriers to healthy eating that exist in Nunavut.

This study was limited by the underrepresentation of men in the present sample and therefore the results may not be applied the entire male Inuit population. This was due to the fact that household members who primarily make decisions regarding food purchase and preparation were targeted.

Conclusions

Consumption of traditional foods is associated with better diet quality and dietary adequacy among Inuit in Nunavut. Efforts should be made to promote good nutrition in these communities through encouraging the use of traditional foods; however, harvesting adequate amounts of these foods may not be feasible for many families. Therefore, in addition to encouraging the retention of traditional eating habits, creative and culturally appropriate strategies are needed to also promote the use of non-traditional foods that are affordable and of high-nutritional quality.

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Declaration of interest

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