ORIGINAL RESEARCH ARTICLE

Traditional food consumption is associated with higher nutrient intakes in Inuit children attending childcare centres in Nunavik

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Objectives. To describe traditional food (TF) consumption and to evaluate its impact on nutrient intakes of preschool Inuit children from Nunavik.
Design. A cross-sectional study.
Methods. Dietary intakes of children were assessed with a single 24-hour recall ($n = 217$). TF consumption at home and at the childcare centres was compared. Differences in children's nutrient intakes when consuming or not consuming at least 1 TF item were examined using ANCOVA.
Results. A total of 245 children attending childcare centres in 10 communities of Nunavik were recruited between 2006 and 2010. The children's mean age was 25.0 ± 9.6 months (11–54 months). Thirty-six percent of children had consumed at least 1 TF item on the day of the recall. TF contributed to 2.6% of total energy intake. Caribou and Arctic char were the most reported TF species. Land animals and fish/shellfish were the main contributors to energy intake from TF (38 and 33%, respectively). In spite of a low TF intake, children who consumed TF had significantly ($p < 0.05$) higher intakes of protein, omega-3 fatty acids, iron, phosphorus, zinc, copper, selenium, niacin, pantothenic acid, riboflavin, and vitamin B_{12}, and lower intakes of energy and carbohydrate compared with non-consumers. There was no significant difference in any of the socio-economic variables between children who consumed TF and those who did not.
Conclusion. Although TF was not eaten much, it contributed significantly to the nutrient intakes of children. Consumption of TF should be encouraged as it provides many nutritional, economic, and sociocultural benefits.

Keywords: *Arctic Canada*; *Inuit*; *traditional food*; *nutrient intake*; *preschool children*; *dietary transition*

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For millennia, Arctic indigenous peoples have been hunter-gatherers with seasonal patterns of food consumption. Traditional foods (TF), defined as plants and animals harvested from the local environment, were vital to their nutrition, health and food security. Nowadays, TF are still beneficial to Arctic peoples for cultural, social, nutritional, psychological, and economic well-being (1–3). However, like many indigenous peoples worldwide, their food patterns have changed during the 20th century as they started to move from a nutrient-dense traditional diet to one centred on store-bought foods (1,4). Because store-bought foods may be limited in diversity and freshness in isolated geographic areas, this shift from an excellent quality diet based on TF to a nutrient-poor market food diet contributes to a decline in diet quality and nutritional status (1,4). This nutrition transition along with other lifestyle changes such as reduced physical activity are among the causes of the growing prevalence of obesity and obesity-related chronic diseases such as type 2 diabetes and cardiovascular diseases (1,4,5).

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Aboriginal peoples inhabiting the Arctic regions of Canada are not apart from this nutrition transition. However, the extent of this phenomenon remains unknown in Inuit children from Nunavik since only 1 study has been conducted in school-aged children (6), and none in preschoolers. In Nunavimmiut women, the consumption of traditional meat was significantly lower in 2004 than in 1992 (7). A study with Inuit adults from Nunavut revealed a significant decrease in energy contribution from traditional food between 1998 and 2008 (8). Several studies among Inuit and Dene/Métis from other Arctic regions of Canada also reported lower TF intakes and an increased reliance on imported market foods among children, youth, and young adults compared with older adults (4,9–12).

Comparing nutrient intakes on days with or without TF can be used to illustrate how nutrient intake can be maximally affected by the nutrition transition (9). Yet, in spite of a low TF intake in Dene/Métis and Yukon First Nations children (4.5% of total energy), those who consumed TF had significantly higher intakes of protein, iron, zinc, copper, magnesium, phosphorus, potassium, vitamin E, riboflavin, and vitamin B_6 than those who did not (13). Moreover, recent data from Nunavut Inuit preschoolers revealed that when compared with non-consumers, children with either a low or a high consumption of TF had higher intakes of protein, iron, and zinc, and lower intakes of carbohydrate (12). Furthermore, those with the highest intake of TF had significantly higher intakes of cholesterol, vitamins A and D, and magnesium compared with non- and low consumers of TF. TF contributed to 8.4% of the total energy intake in these Nunavut children.

To our knowledge, no literature is available regarding present TF consumption, the extent of the dietary transition or its impact on the diet quality of preschool Inuit children from Nunavik. Therefore, we aimed to describe TF consumption and evaluate its association with nutrient intakes in Inuit children attending childcare centres in Nunavik.

Material and methods

Study population and data collection

This research project was a component of the Nutrition Program implemented in childcare centres of Nunavik (northern Québec, Canada). The Nutrition Program that is still in effect today encompasses an intervention component which includes a 4-week cycle menu containing TF in addition to healthy market foods rich in absorbable iron. Cross-sectional data used in this paper came from a prospective study conducted between 2006 and 2010 among children attending 12 childcare centres in 10 communities of Nunavik. Data collections were held yearly during autumn. Parents of Inuit children aged 1–4 years old and attending a childcare centre were contacted and invited to participate, usually by an Inuk from their own community. Those interested were met by a research team member. Information on the study was provided individually, orally or through a DVD available in 3 languages (Inuktitut, English and French). Parents who agreed for their child to participate in the study gave their written informed consent. This study was approved by the Research Ethics Board of the Centre hospitalier de l'Université Laval (CHUQ-CHUL), Québec (Canada).

Dietary assessment

Dietary intakes of children were assessed through the 24-hour recall method. Each recall was completed by a registered dietitian with the parent or main caregiver and with the childcare centre's educator(s) and cook if the child had attended daycare during the day of the recall. Respondents were asked to provide a complete list of all foods and beverages consumed by the child during the 24-hour reference period. Information on cooking methods and brand names were obtained whenever possible. When necessary, dietitians used information on products available at the local grocery store (e.g. brand name, package size) to complete the 24-hour recalls. Three-dimensional graduated food model kits from Santé Québec were used to better standardise recalls. For interviews at the childcare centres, dietitians first met the cook to know which foods were served and then met the child's educator(s) to know which foods he/she ate and the portion size. When the research team was not able to see someone at the childcare centre who could recall the quantity of foods consumed by the child or his/her usual portion size, the standard portion served according to the menu was imputed ($n = 11$). Of the 245 children who were recruited, 28 of them were excluded from the analyses because the 24-hour dietary recall was not done or was incomplete ($n = 27$) or the child was too sick and hardly ate any food ($n = 1$). Thus, a total of 217 complete 24-hour dietary recalls were analysed. A second dietary recall was completed for half of the participants but they are not included in the present analyses. Nutritional supplements were not included in the dietary recalls.

We did not randomly assign the days of data collection between each childcare centre due to logistic limitations. However, all days of the week were almost equally represented with a proportion of 12–20% except for Friday (2%). Nunavik childcare centres are closed over the weekend, making it impossible to meet the staff on Saturday to obtain the foods consumed on Friday. Also, we did not want to collect Friday's intake on Monday as this would have introduced a greater memory bias. The 4 children (2%) for whom we have a dietary recall on Friday had not attended childcare that day or their

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mother was their educator at the childcare and could recall the foods consumed by her child.

Computerization of the 24-hour dietary recalls was done by registered dietitians at the Institut National de Santé Publique du Québec (INSPQ, Québec City). All recalls obtained between 2006 and 2009 were double-checked for coding or data-entry errors by a different dietitian from the INSPQ. Data obtained in 2010 were not double-checked due to a lack of personnel. However, with the experience of the 4 previous years, coding or data entry errors were most likely minimal. Data entry was performed using Micro Gesta software (14). This software relies on the Canadian Nutrient File (15) for the nutrient content of foods. All recipes served in childcare centres were added to the database using nutrient and humidity loss based on standard recipes from the US Department of Agriculture. The nutrient content of infant formulas and some new products was added manually into the database according to the information provided by manufacturers.

For breastfed children, we used the classification of Brown et al. who defined, for 12–23 months old children from industrialized countries, 3 categories of human milk intake and their corresponding energy contribution: low = 0 kcal; average = 313 kcal; high = 669 kcal (16). Blaney attributed a number of feedings per day to each of these categories: low intake = 1–3 feedings/day; average intake = 4–6 feedings/day; high intake $\geq$ 7 feedings/day (17). Thus, based on 70 kcal per 100 g of human milk (15), 0 g, 447 g and 956 g of human milk were attributed to all children who had respectively 1–3, 4–6, and $\geq$ 7 feedings on the reference day. We hypothesized that for the same number of feedings, children over 24 months of age would consume similar amounts of milk than children aged 12–23 months.

Crowding assessment

Household crowding was defined as more than 1 person per room (18) where rooms corresponded to bedrooms plus 2 additional rooms representing the kitchen and the living room (8).

Statistical analyses

Statistical analyses were conducted using SAS 9.2 (SAS Institute Inc. Cary, NC, USA). Frequencies (%) and means were used to describe socio-economic status of participating children. Chi-square and t-test analyses were performed to assess differences in socio-economic variables between consumers and non-consumers of TF. Differences in TF intake as percentages of total energy intake by community as well as differences in nutrient intakes between TF consumers and non-consumers were examined using analysis of covariance (ANCOVA) with SAS Proc Mixed. Adjustments were made for the following variables: day of the week, age and sex. Adjustment was also made for energy intake when verifying differences in micronutrient intakes between TF consumers and non-consumers.

A log-normal transformation was performed for variables not normally distributed. A p-value < 0.05 was considered to be statistically significant.

Results

Participating children were living in Inukjuak (24%), Kuujjuaq (14%), Kangiqsujuaq (14%), Kangiqsualujjuaq (13%), Salluit (10%), Kuujjuarapik (10%), Quaqtaq (8%), Umiujaq (3%), Ivujivik (2%) and Akulivik (2%) (data not shown). Their mean age was 25.0 ± 9.6 months (11–54 months), 52% of them were male, 18% were still being breastfed (no one was exclusively breastfed), and 59% attended a childcare centre during the day of the recall (Table I). Thirty-six percent (36%) of the children ate at least 1 TF item during the day of the recall. There was no significant difference in any of the socio-economic variables between children who consumed TF and those who did not.

As illustrated in Fig. 1, $<3\%$ (2.6%) of the total energy intake consumed on the reference day came from TF. Among TF consumers, TF contributed to 7.6% (range 0.8–35.8%) of the total energy intake (data not shown).

The percentage of energy derived from TF was statistically different between villages. The contribution of TF to total energy intake was higher in more northern Inuit communities than in southern ones, Ivujivik having the highest consumption (10.5%) and Umiujaq, the lowest (0.4%). TF consumption was more elevated on the Hudson coast than on the Ungava coast although the difference between coasts was not statistically significant.

Table II lists all TF items that were mentioned during the 24-hour dietary recalls. A total of 34 different TF items from 16 animal and vegetal species were reported. Caribou and Arctic char were the most frequently mentioned (16% and 10% of the recalls, respectively). A higher number of TF items were reported at home than at the childcare centres; still 3 items consumed at the childcare centre were not consumed at home (skinless baked salmon and skinless boiled Arctic char and trout). Also, baked Arctic char was the most reported TF item at the childcare centres and it was consumed more often than at home. No organ meat was reported in the recalls. When classified into categories, land animals, fish and shellfish, and marine mammals contributed together to more than 90% of the total energy intake from TF (Fig. 2; 38, 33 and 21%, respectively). More than half of the total energy intake from TF came from food harvested from the sea (54%).

Tables III and IV show differences in macronutrient and micronutrient intakes for children with and without TF. TF consumers had significantly higher intakes of protein, omega-3 fatty acids, iron, phosphorus, zinc, copper, selenium, niacin, pantothenic acid, riboflavin,

Table I. Descriptive characteristics of participants

	Total (n = 217)	With TF (n = 78)	Without TF (n = 139)	p[a]
Child characteristics				
Sex (%)				0.23
Male	51.6	16.6	35.0	
Female	48.4	19.4	29.0	
Age (months)	25.0	25.9	24.5	0.30
Breastfeeding status (%)				1.00
Never breastfed	30.7	11.2	19.5	
Have been breastfed	51.2	18.6	32.6	
Still breastfed	18.1	6.5	11.6	
Attended childcare centre[b]				0.15
Yes	59.0	23.5	35.5	
No	41.0	12.4	28.6	
Respondent characteristics				
Marital status (%)				0.24
Married/Common law/Living with a partner	71.4	24.0	47.5	
Single/Divorced/Widowed	28.6	12.0	16.6	
Secondary school completed (%)				0.92
Yes	40.6	14.8	25.8	
No	59.5	21.2	38.3	
Employment status (%)				0.55
Yes	85.3	30.0	55.3	
No	14.8	6.0	8.8	
Household characteristics				
Adults at home (n)	2.8	2.8	2.8	0.94
Children at home (n)	2.9	3.2	2.8	0.08
Crowding (%)[c]	48.4	56.4	43.9	0.08

TF = Traditional food.
[a]p-value derived from chi-square and t-test analyses.
[b]On the day of the 24-hour dietary recall.
[c]Defined as more than 1 person per room where the number of rooms includes bedrooms, kitchen and living room.

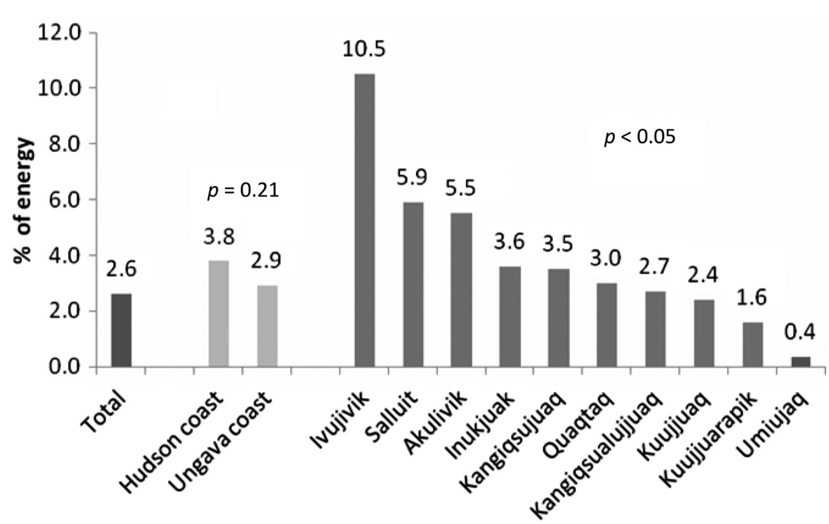

Fig. 1. Traditional food intake as percentage of total energy intake by community (n = 217 children) after adjustment for the following variables: day of the week, age and sex.

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Table II. Traditional food items reported in 24-hour dietary recalls (n = 217)

			Total		Home[a]		Childcare centre	
Species	Part	Preparation	n	% of recalls	n	% of recalls	n	% of recalls
Caribou	Meat	Baked	15	6.9	10	4.6	5	2.3
Arctic char	Flesh	Baked	14	6.5	3	1.4	11	5.1
Caribou	Meat	Fried	7	3.2	7	3.2	–	–
Arctic char	Flesh	Raw	5	2.3	5	2.3	–	–
Caribou	Meat	Boiled	5	2.3	3	1.4	2	0.9
Caribou	Meat	Raw	5	2.3	4	1.8	1	0.5
Seal	Meat	Boiled	5	2.3	4	1.8	1	0.5
Beluga	Fat	Raw	4	1.8	4	1.8	–	–
Blackberries	Berries	Raw	4	1.8	4	1.8	–	–
Goose	Flesh	Boiled	4	1.8	2	0.9	2	0.9
Salmon	Flesh	Baked	4	1.8	–	–	4	1.8
Beluga	Skin	Raw	3	1.4	3	1.4	–	–
Blueberries	Berries	Raw	2	0.9	2	0.9	–	–
Caribou	Meat	Frozen	2	0.9	2	0.9	–	–
Cod	Flesh	Fried	2	0.9	2	0.9	–	–
Fish	Roe	Raw	2	0.9	2	0.9	–	–
Mussels	Flesh	Boiled	2	0.9	2	0.9	–	–
Seal	Fat	Raw	2	0.9	2	0.9	–	–
Redberries	Berries	Raw	2	0.9	2	0.9	–	–
Arctic char	Flesh	Boiled	1	0.5	–	–	1	0.5
Arctic char	Flesh	Frozen	1	0.5	1	0.5	–	–
Arctic char	Skin and flesh	Boiled	1	0.5	1	0.5	–	–
Caribou	Meat	Dried	1	0.5	1	0.5	–	–
Clam	Flesh	Boiled	1	0.5	1	0.5	–	–
Duck	Flesh	Baked	1	0.5	1	0.5	–	–
Mussels	Flesh	Frozen	1	0.5	1	0.5	–	–
Seal	Meat	Frozen	1	0.5	1	0.5	–	–
Seal	Meat	Raw	1	0.5	1	0.5	–	–
Trout	Flesh	Boiled	1	0.5	–	–	1	0.5
Trout	Flesh	Frozen	1	0.5	1	0.5	–	–
Trout	Flesh	Raw	1	0.5	1	0.5	–	–
Whitefish	Flesh	Boiled	1	0.5	1	0.5	–	–
Whitefish	Flesh	Fried	1	0.5	1	0.5	–	–
Whitefish	Flesh	Raw	1	0.5	1	0.5	–	–

[a]Home includes food eaten at home and all other places except the childcare centre (e.g. at a relative or friend's place).

and vitamin B_{12}, and lower intakes of energy and carbohydrate than non-consumers.

Discussion

Although traditional foods represented a small proportion of these Inuit children's diet, they contributed significantly to higher intakes of a number of essential nutrients. A lower proportion of Inuit children in this study had consumed TF compared with Inuit preschoolers from Nunavut (12), and Dene/Métis and Yukon First Nations children (13) (36% vs. 46% and 59%, respectively) (all dietary data were collected using the 24-hour recall method). Also, the number of traditional food items consumed by our participants (16 items) was lower than that observed in Inuit preschoolers from Nunavut (24 items) (12). These 2 results might be explained by several factors. Children in the present study were younger (2.1 years) than Inuit preschoolers from Nunavut (4.4 years old) (12), and Dene/Métis and Yukon First Nations children (10–12 years old) (13), and might have been less likely than older children to have tried a variety of TF. Also, Nakano et al. (13) collected their data between August and October which partly corresponds with the peak season for TF consumption identified in Dene/Métis (October–November) (9), whereas we collected our data between October and

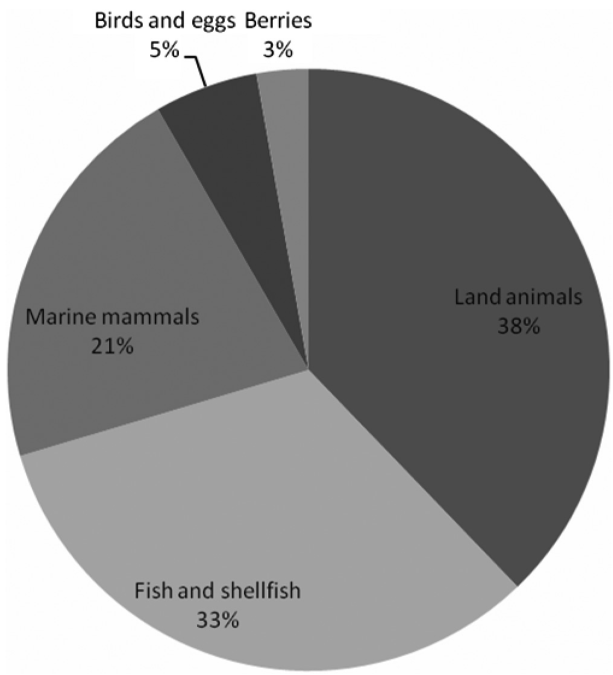

Fig. 2. Traditional food (TF) category as percentages of TF energy intake by children consuming TF (n = 78).

December, representing the season with the lowest TF consumption by Inuit (4,7). Moreover, most of the children in the present study lived in communities further South compared with children from the 2 other studies (12,13). In Dene/Métis and Yukon First Nations children, TF were found to be consumed more often in Northern communities than in those further South (13). A similar decreasing gradient was also observed within the communities of the present study. The proximity to animal migration routes, and prevalent fishing and hunting practices (9) could explain this observation.

Energy contribution from TF in participating children (2.6%) was similar to the one of native children from Northern Alberta (2–4%) (19), but lower than in Dene/Métis and Yukon First Nations children (4.5%) (13), Inuit preschoolers from Nunavut (8.4%) (12), and Inuit children and adolescents from Baffin Island (16%) (20). TF also contributed less to the energy intake than what was reported in adults from the Canadian Arctic (13–40%) (7,9,21). These findings are in general agreement with studies showing that younger generations of Arctic peoples are more affected by the nutrition transition and are consuming less TF than older generations (7,11).

Caribou and Arctic char were the most eaten species by our participants, whereas in Nunavut preschoolers, caribou and beluga were the most consumed species (12). Differences in TF items reported at home and at the childcare centres are very informative. They indicate that species eaten and preparation methods used (e.g. raw, frozen) are more varied and traditional at home. This is to be expected because childcare centres have certain limitations that need to be considered (e.g. time required to pluck several geese, low availability of traditional foods) and because cooks are following a menu with specified preparation methods (e.g. without frying).

Children who consumed TF on the reference day had a lower energy intake than non-consumers. The lower energy intake among consumers is probably related to a lower intake of grain products and other carbohydrate-rich foods as indicated by their lower energy-adjusted carbohydrate intake. A lower percent energy as carbohydrate in TF consumers was also observed in preschool Nunavut children (12). However, the lower energy intake observed in children who ate TF is not in agreement with results observed in Dene/Metis and Yukon First Nations children (13), and Nunavut Inuit preschoolers (12) where no significant differences were observed. As mentioned earlier, children in the present study were younger than in the studies mentioned above. Compared with older children, younger children can less easily help themselves to food at home or buy food away from home. Also, older children can override their satiety signals as external

Table III. Energy and macronutrient intakes as percentage of total energy[a] by children with and without traditional food (TF)

Variables	With TF (n = 78)	Without TF (n = 139)	p
Energy (kJ)	4647 ± 206	5177 ± 178	< 0.05
Protein	17.4 ± 0.5	14.8 ± 0.5	< 0.0001
Carbohydrate	51.0 ± 1.1	53.8 ± 1.0	< 0.05
Fat, total	32.5 ± 0.9	32.7 ± 0.8	0.88
Trans fat	0.8 ± 0.1	0.7 ± 0.1	0.44
Saturated fat	13.0 ± 0.5	13.5 ± 0.4	0.36
Monounsaturated fat	11.5 ± 0.4	11.5 ± 0.3	0.89
Polyunsaturated fat	4.6 ± 0.2	4.4 ± 0.2	0.38
Omega-3 fatty acids	0.8 ± 0.0	0.6 ± 0.0	< 0.0001
Omega-6 fatty acids	3.5 ± 0.2	3.4 ± 0.2	0.65

[a]Values are least squares means ± standard errors adjusted for the following variables: day of the week, age, and sex.

Table IV. Nutrient intakes[a] by children with and without traditional food (TF)

Nutrients	With TF (n = 78)	Without TF (n = 139)	p
Fibres (g)	6.7 ± 0.4	6.7 ± 0.3	0.98
Calcium (mg)	878.5 ± 50.7	863.0 ± 43.4	0.79
Iron (mg)	10.7 ± 0.6	9.1 ± 0.5	< 0.01
Magnesium (mg)	160.7 ± 5.2	155.4 ± 4.5	0.37
Phosphorus (mg)	1011.8 ± 42.6	901.3 ± 36.4	< 0.05
Potassium (mg)	2018.2 ± 65.0	1904.8 ± 55.6	0.13
Sodium (mg)	1387.9 ± 58.3	1399.0 ± 49.8	0.87
Zinc (mg)	7.3 ± 0.3	6.6 ± 0.2	< 0.05
Copper (μg)	747.9 ± 27.5	671.8 ± 23.5	< 0.05
Manganese (mg)	1.4 ± 0.1	1.4 ± 0.1	0.89
Selenium (mg)	59.9 ± 2.6	53.9 ± 2.3	< 0.05
Betacarotene (μg)	958.4 ± 132.0	870.0 ± 112.9	0.56
Vitamin A (μg RAE[b])	490.4 ± 26.1	444.7 ± 22.3	0.12
Folate (μg DFE[b])	178.1 ± 9.6	191.9 ± 8.2	0.21
Niacin (mg NE[b])	22.6 ± 0.9	18.9 ± 0.7	< 0.001
Pantothenic acid (mg)	4.6 ± 0.2	4.0 ± 0.1	< 0.01
Riboflavin (mg)	1.8 ± 0.1	1.6 ± 0.1	< 0.05
Thiamin (mg)	1.0 ± 0.0	1.0 ± 0.0	0.35
Vitamin B_6 (mg)	0.8 ± 1.0	0.8 ± 1.0	0.54
Vitamin B_{12} (μg)	5.0 ± 0.3	3.2 ± 0.3	< 0.0001
Vitamin C (mg)	152.6 ± 11.7	158.0 ± 10.1	0.69
Vitamin D (UI)	320.8 ± 22.2	286.0 ± 19.0	0.17
Vitamin E (ug)	3.1 ± 0.3	3.0 ± 0.3	0.77
Vitamin K (μg)	25.8 ± 2.6	23.3 ± 2.2	0.39
Cholesterol (mg)	172.4 ± 14.8	151.5 ± 12.6	0.22

[a]Values are least squares means ± standard errors adjusted for the following variables: energy intake, day of the week, age, and sex.
[b]RAE, retinol activity equivalent; DFE, dietary folate equivalent; NE, niacin equivalent.

factors often exert more influence on their food intake than internal cues (22), whereas young children generally stop eating when they feel full. Thus, younger children consuming protein-rich TF would be more responsive than older children to the satiety signals induced by protein in the short term. This could partly explain the lower energy intake observed among consumers of TF in this study, whereas no significant difference was reported in studies done in older children.

Overall, children in this present study had a significantly lower energy intake than that reported in 1–3 year-old children participating in the 2004 Canadian Community Health Survey, Cycle 2.2 (6174 kJ) (23). Nevertheless, parents in the CCHS were believed to have overestimated the dietary intakes of their children (24). For any parent, an unconscious wish to portray their child as eating well or the difficulty to estimate the amount actually consumed by the child rather than the amount offered may lead to overestimation of energy intake (25). In Nunavik, additional factors might be involved. Inuit people customarily eat when they are hungry, thus many Inuit do not regularly eat scheduled meals (7). This could have represented an important bias when evaluating participants' food intakes. Moreover, the cultural context of Nunavik may make it difficult to use the food measurement models which may cause participants to underestimate, but also overestimate the portion size of some foods (7). For Inuit parents (and childcare centres' staff) reporting TF serving size might be a challenge as it is often served or taken by hand, one mouthful at a time, from a centre dish, with other family members (or staff) participating in the service. This could lead to underestimation or overestimation of food intake. Food insecurity is also frequent in Nunavik (7) and could be another explication for the lower caloric intake observed in our participants. In the Nunavik Inuit Health Survey, 24% of the adults interviewed indicated they had lacked food during the month before the survey (7). In our study, some parents effectively mentioned during the interview that they were short of food. Food insecurity can lead to recurring hunger and lower caloric intake, although the least severe level of food insecurity can compromise the quality of the family diet and often leads to a higher energy intake from foods that contain more fat and carbohydrate (26).

Children who consumed TF on the day of the recall had a significantly higher protein intake and as mentioned before, a lower carbohydrate intake which confirm results observed in Inuit preschoolers (12) and Dene/Métis and Yukon First Nations children (protein only) (13). This is consistent with Inuit TF, that are mostly composed of meat, fish, and birds, all being high sources of protein and low sources of carbohydrate. Also, in accordance with results from these 2 studies, we did not observe any difference in the intake of fat (total), saturated fat, or polyunsaturated fat (total) between consumers and non-consumers of TF. However, contrary to results reported by Nakano et al. (13), we observed a higher intake of omega-3 fatty acids in children who had eaten TF. This result may be explained by the type of TF eaten; children in the present study ate more fish, shellfish and marine mammals, all great sources of omega-3 fatty acids compared with Dene/Métis and Yukon First Nations children (54% vs. 11% of energy intake by children consuming TF).

Significantly higher intakes of iron, phosphorus, zinc, copper, selenium, niacin, pantothenic acid, riboflavin, and vitamin B_{12} were seen in children who had consumed TF. This result corroborates findings from other studies in the Arctic where most micronutrient intakes improve when TF are consumed, even in small amounts (1,7,9, 11–13,27). This is not surprising since the Arctic food web is based on traditional meat and fish that contain many essential nutrients. Although significant, some differences in nutrient intakes seem relatively small in absolute terms. However, when they are compared with the estimated average requirement (EAR) (28), they are not negligible and represent between 28 and 74% of the EAR for children aged 1–3 years old with vitamin B_{12} reaching 260% of its EAR. In the long term, these differences will have a negative impact on the nutritional status of non-consumers.

When interpreting our results, one should keep in mind that while the 24-hour dietary recall method is useful, it does have limitations (29). Indeed, recalls are retrospective and depend on the respondent's memory and cooperation. Nevertheless, we took measures to reduce these limits such as visits to the local grocery store and childcare centres' kitchen in order to obtain more information about foods (eg. brand names, package size). Proxy reporting may also have affected accuracy of the recalls. Indeed, daycare staff has to provide care to more than 1 child, and they might not remember the exact amount of food consumed by a specific child (24).

In conclusion, we observed higher intakes of most nutrients in children who consumed TF. This is especially meaningful when so little energy is consumed as TF (27). TF are extremely important for dietary quality in Arctic populations (2,11). Therefore, results from this study reiterate the importance of consuming TF in the Arctic and more so for young children who have higher nutrient needs.

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References

1. Kuhnlein HV, Receveur O. Dietary change and traditional food systems of indigenous peoples. Annu Rev Nutr. 1996;16:417–42.
2. Deutch B, Dyerberg J, Pedersen HS, Aschlund E, Hansen JC. Traditional and modern Greenlandic food – dietary composition, nutrients and contaminants. Sci Total Environ. 2007;384:106–19.
3. Vaktskjold A, Deutch B, Skinner K, Donaldson SG. Food, diet, nutrition and contaminants. In: Hansen JC, Van Oostdam J, Gilman A, Odland JØ, Vaktskjold A, Dudarev A, editors. AMAP Assessment 2009: human health in the Arctic. Oslo: Arctic Monitoring and Assessment Programme; 2009. p. 21–48.
4. Kuhnlein HV, Soueida R, Receveur O. Dietary nutrient profiles of Canadian Baffin Island Inuit differ by food source, season, and age. J Am Diet Assoc. 1996;96:155–62.
5. Donaldson SG, Van Oostdam J, Tikhonov C, Feeley M, Armstrong B, Ayotte P, et al. Environmental contaminants and human health in the Canadian Arctic. Sci Total Environ. 2010;408:5165–234.
6. Muckle G, Dewailly É, Ayotte P, Plusquellec P, Jacobson JL, Jacobson SW, et al. Nunavik cohort study on exposure to environmental contaminants and child development. In: Smith S, Stow J, Edwards J, editors. Synopsis of research conducted under the 2007–2008 Northern Contaminants Program. Ottawa: Minister of Indian Affairs and Northern Development; 2008. p. 26–34.
7. Blanchet C, Rochette L. Nutrition and food consumption among the Inuit of Nunavik. Nutrition Inuit Health Survey 2004, Qanuippitaa? How Are We? Québec: Institut National de la Santé Publique du Québec (INSPQ) and Nunavik Regional Board of Health and Social Services (NRBHSS); 2008. p. 1–87.
8. Egeland GM, Williamson-Bathory L, Johnson-Down L, Sobol I. Traditional food and monetary access to market-food: correlates of food insecurity among Inuit preschoolers. Int J Circumpolar Health. 2011;70(4):373–83.
9. Receveur O, Boulay M, Kuhnlein HV. Decreasing traditional food use affects diet quality for adult Dene/Metis in 16

communities of the Canadian Northwest Territories. J Nutr. 1997;127:2179–86.
10. Egeland GM, Berti P, Soueida R, Arbour LT, Receveur O, Kuhnlein HV. Age differences in vitamin A intake among Canadian Inuit. Can J Public Health. 2004;95:465–9.
11. Kuhnlein HV, Receveur O. Local cultural animal food contributes high levels of nutrients for Arctic Canadian indigenous adults and children. J Nutr. 2007;137:1110–4.
12. Johnson-Down L, Egeland GM. Adequate nutrient intakes are associated with traditional food consumption in Nunavut Inuit children aged 3–5 years. J Nutr. 2010;140:1311–6.
13. Nakano T, Fediuk K, Kassi N, Kuhnlein HV. Food use of Dene/Metis and Yukon children. Int J Circumpolar Health. 2005;64:137–46.
14. Nutritional Evaluation Program Software [computer program]. Version 1.1.56. Québec: Micro-Gesta; 2006.
15. Health Canada. Canadian nutrient file. Version 2007b. Ottawa: Health Canada.
16. World Health Organization. Complementary feeding of young children in developing countries: a review of current scientific knowledge. WHO/NUT/98.1. Geneva: World Health Organization; 1998. p. 1–228.
17. Blaney S. Contribution des ressources naturelles à la sécurité alimentaire et à l'état nutritionnel d'une population rurale d'une aire protégée du Gabon. [dissertation]. Quebec: Université Laval; 2007.
18. Statistics Canada. Aboriginal peoples in Canada in 2006: Inuit, Métis and First Nations, 2006 census. Ottawa: Statistics Canada; January 2008. Catalogue No. 97-558-XIE. p. 1–53.
19. Wein EE, Gee MI, Hawrysh ZJ. Food consumption patterns of native school children and mothers in northern Alberta. J Can Diet Assoc. 1992;53:267–73.
20. Berti PR, Hamilton SE, Receveur O, Kuhnlein HV. Food use and nutrient adequacy in Baffin Inuit children and adolescents. Can J Diet Pract Res. 1999;60:63–70.
21. Kuhnlein HV, Receveur O, Chan HM. Traditional food systems research with Canadian indigenous peoples. Int J Circumpolar Health. 2001;60:112–22.
22. Ello-Martin JA, Ledikwe JH, Rolls BJ. The influence of food portion size and energy density on energy intake: implications for weight management. Am J Clin Nutr. 2005;82 (Suppl 1):S236–41.
23. Canadian community health survey (CCHS), cycle 2.2, nutrition. Nutrient intakes from food. Provincial, regional and national summary data tables. Vol. 1. Ottawa: Health Canada, Statistics Canada; 2004. 26 p.
24. Canadian community health survey (CCHS), cycle 2.2, nutrition (2004). A guide to accessing and interpreting the data. Ottawa: Health Canada; 2006.
25. Devaney B, Ziegler P, Pac S, Karwe V, Barr SI. Nutrient intakes of infants and toddlers. J Am Diet Assoc. 2004; 104(Suppl 1):S14–21.
26. Tanumihardjo SA, Anderson C, Kaufer-Horwitz M, Bode L, Emenaker NJ, Haqq AM, et al. Poverty, obesity, and malnutrition: an international perspective recognizing the paradox. J Am Diet Assoc. 2007;107:1966–72.
27. Kuhnlein HV, Receveur O, Soueida R, Egeland GM. Arctic indigenous peoples experience the nutrition transition with changing dietary patterns and obesity. J Nutr. 2004;134: 1447–53.
28. Institute of Medicine. Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. Washington, DC: National Academy Press; 2001. p. 770–73.
29. Gibson RS. Principles of nutritional assessment. 2nd ed. New York: Oxford University Press; 2005. p. 105–28.

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