Decreasing Traditional Food Use Affects Diet Quality for Adult Dene/Métis in 16 Communities of the Canadian Northwest Territories[1,2]

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ABSTRACT We assessed diets in 16 Dene/Métis communities in the Canadian Arctic. We described nutrient intakes and identified nutrients at risk among adult Dene/Métis, evaluated the influence of traditional food on diet quality, and examined the direction of dietary change by comparing intergenerational and between-community differences in dietary intake. Diet varied according to sex, age and community. Nutrients of possibly inadequate intake (irrespective of subject sex, age or community) included calcium, vitamin A and folic acid. Dietary fiber intake was also of concern. Traditional food (animals and plants harvested from the local environment) was consumed on 65.4% of interview days; on those days intakes of iron, zinc and potassium were higher ($P < 0.05$) and those of sodium, fat, saturated fat and sucrose were lower ($P < 0.05$) than on days when market food only was consumed. In this population, the shift away from traditional food towards a diet composed exclusively of market food was characterized by an increase ($P < 0.05$) in absolute energy intake and an increase ($P < 0.01$) in the relative contributions of carbohydrate (particularly sucrose), fat and saturated fat. This pattern of change calls for initiatives to document the current health status of this population and to prevent potential negative health consequences of dietary change. J. Nutr. 127: 2179–2186, 1997.

KEY WORDS: • *Arctic Canada* • *indigenous peoples* • *dietary change* • *humans*

Diets of Arctic and Subarctic indigenous peoples have been the subject of growing interest because of concerns about the presence of organochlorine and heavy metal contaminants, as well as concerns over the health implications of a shift away from traditional food. Long-range atmospheric and oceanic transport and local sources of contamination have been described (Barrie et al. 1992, Lockhart et al. 1992, Muir et al. 1992, Shearer 1997, Thomas et al. 1992), and the role of traditional food as the main source of exposure has been emphasized (Kinloch et al. 1992, Kuhnlein et al. 1995b).

Traditional food is food, both plant and animal, harvested from the local environment, in comparison to market food, which is commercial food shipped from the south. Although traditional food is a source of contaminants, and apparently more so in the eastern than the western Canadian Arctic (Chan et al. 1995 and 1997, Kuhnlein et al. 1995b), it is also a source of important nutritional, social and cultural benefits (Kuhnlein 1995, Kuhnlein and Receveur 1996, Receveur and Kuhnlein 1997).

In the western Canadian Arctic, the territories of the Dene/Métis, food systems have been described in a few communities. Szathmary and co-workers (Ritenbaugh et al. 1996, Szathmary et al. 1987) investigated the relationships between dietary change and its potential effect on glucose metabolism among Dogrib Dene/Métis. Wein and colleagues described the food system of the Fort Smith Dene/Métis in terms of diet quality, with particular attention to the contribution of traditional food to the total diet (Wein et al. 1991a and 1991b). Our previous work focused on Sahtú Dene/Métis and characterized some of the benefits and risks of the current diet (Kuhnlein et al. 1991, 1994, 1995a and 1995b, Kuhnlein and Soueida 1992, Morrison et al. 1995).

Following these reports, The Dene Nation and Métis Nation of the Northwest Territories suggested that all Dene/Métis communities might benefit from studies of the relationships between diet and health and from assessments of type and quantities of traditional and market food being consumed. A participatory research procedure was therefore developed to *1*) establish a baseline dietary intake that future dietary studies could use to assess change in food intake; *2*) improve understanding of how food practices convey different benefits or risks with regard to nutrients and contaminants and also culturally and economically; and *3*) identify food- and nutrition-related concerns and potential food and nutritional problems in the community.

Results of this study were reported to the communities through workshops, posters, radio interviews and a final report (Receveur et al. 1996). In this article we present methods used in this study and results of dietary assessment based on 24-h recalls. This analysis focused on describing nutrient intakes and identifying nutrients at risk of inadequate intake. We then evaluated the influence of traditional food on diet quality and examined the direction of dietary change by comparing intergenerational and between-community differences in dietary

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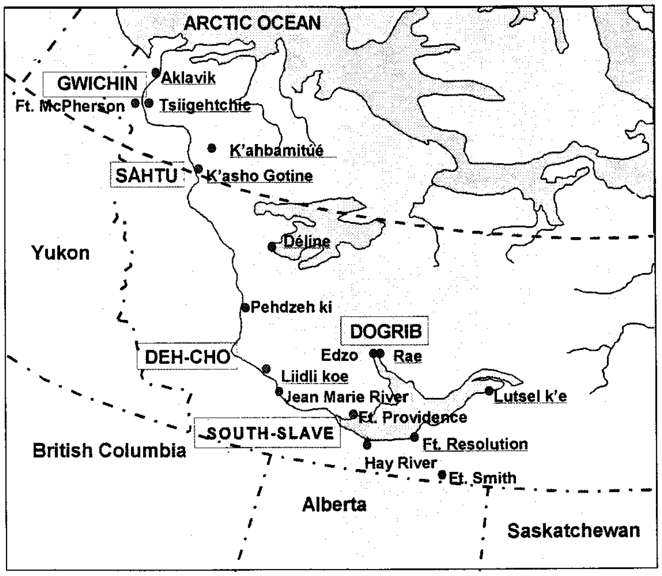

FIGURE 1 Survey location: underlined Dene and Métis communities participated in late winter and fall of 1994; other communities participated only in fall 1994. Regions are in boxes.

intake. Other reports will provide estimates of exposure to contaminants through traditional food consumption and consider the sociocultural and economic dimensions of the food system.

SUBJECTS AND METHODS

The Dene are Athabascan speakers who have inhabited the forests and barrens of the continental Northwest Territories for at least the last 2500 y (Northwest Territories Data Book 1990). Métis combine European (usually French) and aboriginal ancestry. Together numbering approximately 18,000 persons, Dene/Métis form the majority of the population in the study area named Denendeh, a large area encompassing approximately 308,000 square miles (The Dene Nation 1984) of lakes, muskeg and boreal forests east of the Mackenzie Mountains and west of the barrenlands, limited on the north by the Arctic Ocean and on the south by the provincial borders of British Columbia, Alberta and Saskatchewan. Central to Denendeh is the basin of the Deh-Cho River (also called Mackenzie River) (**Fig. 1**).

Participation in this study was extended to all 27 Dene/Métis communities except the communities of Dettah and Ndilo (both close to Yellowknife, the capital of the Northwest Territories), where similar projects were conducted by regional health services. Nine communities participated during March-April 1994 and again in October-November 1994 together with seven new communities (Fig. 1). The March-April interview period was selected to represent the time of the year with lowest traditional food consumption, and October-November was selected to reflect the peak of traditional food consumption.

Individual interviews were the primary instruments used in this study. The format of these was developed in consultation with members of the Dene Nation and the Métis Nation of the Northwest Territories, and the interviews incorporated comments and suggestions collected in 1993 during individual and community meetings in 15 Dene/Métis communities. The present project was approved by the McGill University Ethical Review Committee and a license was obtained from the Northwest Territories Science Institute. Each community developed a "research agreement" with the researchers (Scott and Receveur 1995).

After negotiation of the "research agreement" with community leaders, each community was informed through posters and radio messages of the intent of the project. A random sample of 10% of the Dene/Métis households or 25 households, whichever was larger, was drawn from existing band, housing and utility lists. One man and one woman from each household were invited to participate. When one man or one woman was not present in the household for interviewing, another person from an additional randomly selected household was contacted. In small communities (Tsiigehtchic, K'áhbamit'úé, Jean Marie River, Pehdzeh Ki) all households were invited to participate. Although a random sample of sufficient size is the best guarantee that results will be generalizable to the community at large, bias may still occur. For example, traditional food intake may be underestimated if the interviews are conducted at a time when a large number of high consumers of traditional food are out of the community (i.e., "on the land"). Care was taken to avoid interviewing at those particular times. Dietary interviews started in October, after the peak of the fall hunt, and again in March, the time of lowest expected traditional food use. Participation was confidential and voluntary; 91% of selected persons agreed to participate.

In each community, a project coordinator, generally a research-trained dietitian, worked with the local interviewer for the duration of data collection to provide guidance and ensure quality control. Interviewers were trained to administer interviews in English or the local language (there were four local languages in the study area), at the respondent's choice. Each interview lasted approximately 1 h and included the following:

1. Traditional food frequency questionnaire, in which participants were asked the frequency of consumption of traditional food in the 3 mo prior to the visit. The complete list of known available traditional foods included 34 animal species, with questions on specific parts and organs within each species, and 19 plant species.
2. A 24-h recall, in which participants were asked to remember in detail the type and quantities of food consumed on the day prior to the visit.
3. Sociocultural questionnaire, in which participants were asked 27 questions related to household demography, food preferences and perceptions related to traditional and market food.
4. A harvest calendar and market food price list, completed within each community. The harvest calendar illustrated seasonal harvesting patterns, and the food price list consisted of the 46 items of the Northern Food Basket previously used in other northern communities (Hill et al. 1994, Wein 1994).

To facilitate recalls, each interviewer was provided with an illustrated index of all traditional food species listed in the traditional food frequency questionnaire, three-dimensional portion models (bowls, cups and spoons locally available) and two-dimensional serving-size representations of bannock (a frequently consumed quickbread usually of white flour) for use in the 24-h recall. Each record was checked in the field for completeness. Respondents reporting daily intakes of more than 17,672 kJ or less than 4418 kJ were contacted again to ensure the exactitude of the record: when in doubt, a second recall was completed and the first was discarded (this occurred for eight of the 1012 dietary records). Alcohol intake is not included in the data set. Alcohol consumption is prohibited in some communities, and it can therefore be expected that reports of alcohol consumption may not be comparable across communities.

Nutrient analyses were performed using two food composition databases: *1*) a database of the composition of traditional Dene/Métis food derived from published reports (Appavoo et al. 1991, Kuhnlein et al. 1994, Morrison and Kuhnlein 1993) supplemented with traditional food previously analyzed from samples collected in the eastern Arctic (Kuhnlein and Soueida 1992, Kuhnlein et al. 1991); and *2*) a market food composition database (Murphy and Gross 1987) derived from Agricultural Handbook No. 8 series adjusted to include Canadian-particular food items and nutrient fortification levels (Thompson and Brulé 1992). Dietary fiber and sucrose contents of traditional food were assumed to be zero for animal food and equivalent to those of commercial berries in the case of local berries, the only traditional plant food reported consumed during the seasons of interview. There were no missing values for market food. For traditional food, 110 out of the 1214 occurences reported in the 24-h recalls had missing food composition data. Forty of the 110 were for moose and caribou ribs, for which moose or caribou flesh was substituted. Other traditional food items with missing values included rarely eaten food parts such as moose nose, tongue or stomach, for which a substitute was used (moose flesh in those examples).

TABLE 1

Community characteristics and sample size in late winter (March–April) and fall (October–November) 1994

Region/communities	Population size	Latitude	Year-round road access[1]	Sample size (*n*)		
				March–April	Oct–Nov	Total
Gwich'in						
Aklavik	777	68°13′	No	47	46	93
Tsiigehtchic	106	67°27′	No*	19	33	52
Ft. McPherson	729	67°26′	No*	—	50	50
Sahtu						
K'áhbamit'úé	52	67°02′	No	14	9	23
K'ásho Got'ine	586	66°15′	No	35	23	58
Déline	550	65°10′	No	48	51	99
Deh-Cho						
Pehdzeh Ki	161	63°14′	No*	—	49	49
Liidli Kóé	1006	61°52′	No*	49	50	99
Jean Marie River	66	61°31′	No	—	20	20
Ft. Providence	577	61°21′	No*	—	49	49
Dogrib						
Rae and Edzo	1443	62°50′	No*	50	59	109
South-Slave						
Lutsel K'e	263	62°24′	No	43	50	93
Ft. Resolution	475	61°10′	Yes	51	46	97
Hay River Dene Reserve	181	60°51′	Yes	—	48	48
Ft. Smith	2505	60°00′	Yes	—	73	73
Total	9477			356	656	1012

[1] "No" means no road access in summer or ice road in winter; "No*" means that road access is temporarily interrupted during freeze-up and break-up; "Yes" is for uninterrupted road access.

A total of 385 and 677 interviews were completed in late winter and fall, respectively. Records showing daily intake of coffee and/or tea exceeding 4 L ($n = 32$) and records from pregnant or lactating women ($n = 18$) were excluded from this analysis. Such levels of tea-coffee consumption were found to markedly affect energy and nutrient intakes, and these records represent a special subgroup to be analyzed separately rather than left in the data set where they disproportionally influence population estimates. Pregnant or lactating women were excluded because the number was insufficient for dietary evaluation. **Table 1** presents the final data set by region and community. For each community, population size, latitude and road access are presented because these community-level variables can readily influence food availability. The proportional age distribution of our sample is presented in **Table 2** and agrees well with the most recent census estimates (Northwest Territories Data Book 1990).

Data were entered using Epi-Info, version 6 (USD Inc., Stone Mountain, GA). After extensive data checking, including double entry of a 10% random subset, data were analyzed with SAS, version 6.10 (SAS Institute, Cary, NC). Descriptive statistics included means or least square means with associated SEM. Least square means were used to adjust for unbalanced sample sizes across communities, age groups and seasons (Searles et al. 1980). In most cases, nutrient intakes did not meet the assumption of normality, and differences between groups were therefore tested by Kruskall-Wallis nonparametric ANOVA (Zar 1984). Macronutrient intakes, expressed as a percentage of total energy intake, were analyzed with parametric ANOVA. Post-hoc comparisons of group means were made with Tukey's multiple pairwise comparisons (Zar 1984). $P < 0.05$ was considered significant in all statistical tests.

TABLE 2

Sample distribution by region, sex and age for participating communities

Sex and age	Region				
	Gwich'in	Sahtù	Dogrib	Deh-Cho	South-Slave
	%				
Women					
20–40 y	24.1	27.2	25.7	33.7	27.3
41–60 y	16.4	10.6	15.7	9.7	15.1
61+ y	11.3	12.8	11.0	7.8	6.4
Men					
20–40 y	26.2	25.5	19.3	23.5	25.4
41–60 y	13.3	15.6	19.3	16.6	16.4
61+ y	8.7	8.3	9.2	9.2	9.3

RESULTS

Dietary intakes and sources of variations. Intakes of energy, macronutrients, saturated and unsaturated fats, vitamin A, selected minerals, dietary fiber and sucrose are reported in **Table 3** by age, sex and season. Energy requirements were likely to be met, with some possible exceptions in the oldest age group. Protein intake was generally high, as were intakes of iron and zinc, which can be expected to be highly bioavailable in this meat-rich diet. Low intakes of vitamin A, calcium and dietary fiber are of concern. Table 3 presents dietary variables for which food composition data exist for both traditional and market food.

Intakes were tested among age groups to assess generational differences and between men and women, adjusted for energy intake, to assess whether men and women tended to consume similar types of food. Differences between the sexes and among age groups were few in March-April and more pronounced in October-November, the period of peak traditional food consumption. A consistent trend across seasons was the higher carbohydrate intake in the youngest generation, which can be accounted for by greater sucrose intake. Another less significant trend was greater saturated fat intake in the youngest generation. Other differences between men and women and among age groups were less readily interpretable and may be

TABLE 3

Average daily energy, nutrient, fiber and sucrose intakes in Dene and Métis communities, by season, sex and age[1]

Intake		March–April 20–40 y (*n* = 83 M, 84 F)	March–April 41–60 y (*n* = 57 M, 53 F)	March–April 61+ y (*n* = 33 M, 46 F)	*P* value[2]	October–November 20–40 y (*n* = 165 M, 196 F)	October–November 41–60 y (*n* = 105 M, 83 F)	October–November 61+ y (*n* = 58 M, 49 F)	*P* value[2]
Energy, *kJ*	M	10,966 ± 494	9422 ± 724	10,222 ± 728	NS	9883 ± 318[a]	10,443 ± 506[a]	8121 ± 548[b]*	0.003
	F	9845 ± 418	8849 ± 540	7791 ± 607	NS	8832 ± 259[a]	8816 ± 402[a]	7326 ± 515[b]	0.03
Carbohydrate, *g*	M	242 ± 14[a]	201 ± 19[b]	179 ± 21[b]	0.0008	232 ± 9[a]*	212 ± 13[a]	163 ± 16[b]*	0.002
	F	256 ± 13[a]	199 ± 15[b]	173 ± 16[b]	0.0001	219 ± 8[a]	199 ± 11[ab]	170 ± 13[b]	0.001
Protein, *g*	M	163 ± 9*	143 ± 13	192 ± 16*	NS	143 ± 6[b]*	176 ± 9[a]	158 ± 12[a]	0.003
	F	121 ± 7	144 ± 12	124 ± 15	NS	107 ± 4[b]	146 ± 9[a]	141 ± 13[a]	0.0001
Fat, *g*	M	110 ± 7	95 ± 10	103 ± 10	NS	95 ± 4[a]	102 ± 7[a]	70 ± 8[b]	0.0005
	F	95 ± 5	80 ± 8	73 ± 9	NS	79 ± 3[a]	79 ± 6[a]	53 ± 7[b]	0.002
Saturated fat, *g*	M	40 ± 3	33 ± 4	35 ± 4	NS	34 ± 2[a]	35 ± 3[a]*	24 ± 3[b]*	0.0001
	F	34 ± 2	28 ± 3	26 ± 3	NS	29 ± 1[a]	27 ± 2[a]	17 ± 3[b]	0.0001
Polyunsaturated fat, *g*	M	17 ± 1	20 ± 3	18 ± 3	NS	17 ± 1	18 ± 2*	13 ± 2	NS
	F	18 ± 1	16 ± 2	14 ± 2	NS	14 ± 1	14 ± 1	11 ± 2	NS
Vitamin A[3], *RE*	M	439 (365–528)[a]	248 (168–366)[b]	257 (144–457)[ab]	0.04	454 (388–532)[a]	413 (336–553)[a]	172 (110–269)[b]	0.001
	F	420 (334–529)	397 (274–575)	243 (152–388)	NS	413 (363–469)[a]	303 (225–409)[ab]	176 (113–272)[b]	0.02
Iron, *mg*	M	24 ± 2	23 ± 3	26 ± 3	NS	22 ± 1*	25 ± 2	22 ± 2	NS
	F	19 ± 1	25 ± 4	17 ± 7	NS	17 ± 1[b]	22 ± 3[a]	27 ± 6[a]	0.0004
Zinc, *mg*	M	22 ± 2*	20 ± 3	25 ± 3	NS	20 ± 1[b]*	25 ± 2[a]	20 ± 2[ab]	0.03
	F	13 ± 4	20 ± 4	18 ± 3	NS	17 ± 2[b]	21 ± 3[a]	18 ± 2[ab]	0.01
Copper, *mg*	M	1.7 ± 0.1	1.8 ± 0.3	1.9 ± 0.2	NS	1.5 ± 0.1[b]	1.9 ± 0.2[a]	1.5 ± 0.2[ab]	0.04
	F	1.4 ± 0.2	2.2 ± 0.6	1.6 ± 0.2	NS	1.5 ± 0.1[a]	1.5 ± 0.5[b]	1.5 ± 0.2[ab]	0.001
Calcium, *mg*	M	547 ± 52	519 ± 62*	492 ± 65*	NS	564 ± 33*	544 ± 43*	412 ± 49	NS
	F	550 ± 46	526 ± 54	548 ± 63	NS	499 ± 28	526 ± 40	478 ± 53	NS
Magnesium, *mg*	M	315 ± 14	296 ± 19	314 ± 25	NS	286 ± 9[b]	316 ± 14[a]	269 ± 19[ab]	0.02
	F	286 ± 14	281 ± 18	257 ± 23	NS	246 ± 8[b]	289 ± 13[a]	263 ± 19[ab]	0.008
Phosphorus, *mg*	M	1752 ± 89*	1624 ± 133	1966 ± 163	NS	1588 ± 58[b]*	1863 ± 93[a]	1651 ± 123[ab]	0.02
	F	1447 ± 70	1646 ± 128	1472 ± 150	NS	1253 ± 44[b]	1633 ± 92[a]	1579 ± 127[ab]	0.0001
Sodium, *mg*	M	3568 ± 257	3294 ± 318	2915 ± 363	NS	3130 ± 165	2886 ± 223	2597 ± 274	NS
	F	3122 ± 195	3363 ± 392	2557 ± 283	NS	2686 ± 120	2556 ± 293	2211 ± 239	NS
Potassium, *mg*	M	3599 ± 176	3327 ± 244	3674 ± 296	NS	3172 ± 113[b]	3661 ± 170[a]	3044 ± 224[b]	0.008
	F	3203 ± 163	3157 ± 208	2715 ± 259	NS	2786 ± 101[b]	3284 ± 155[a]	2870 ± 219[b]	0.004
Dietary fiber, *g*	M	17 ± 1	17 ± 1	12 ± 1	NS	16 ± 1[a]	15 ± 1[a]	10 ± 1[b]	0.0001
	F	17 ± 1[a]	15 ± 1[a]	11 ± 1[b]	0.0001	15 ± 1[a]	14 ± 1[a]	10 ± 1[b]	0.0001
Sucrose, *g*	M	81 ± 6[a]	51 ± 8[b]	43 ± 6[b]*	0.0001	67 ± 4[a]	55 ± 5[b]	37 ± 5[c]	0.0001
	F	81 ± 6[a]	48 ± 7[b]	25 ± 5[c]	0.0001	68 ± 4[a]	51 ± 5[b]	35 ± 4[b]	0.0001

[1] Values are least square means ± SEM adjusted for varying community sample size. M = male, F = female. * Significant sex effect within each season and age category based on Kruskal-Wallis nonparametric ANOVA adjusting for energy intake ($P < 0.05$).

[2] Age effect within each season and sex category, based on Kruskal-Wallis nonparametric ANOVA. Values in the same row with different letter superscripts are statistically different based on Tukey's multiple pairwise comparisons ($P < 0.05$). NS = not significant ($P > 0.05$).

[3] Geometric least square means and 95% confidence intervals. RE = retinol equivalents.

in part obscured as a result of the different number of communities surveyed in each season (nine communities in March-April and 16 in October-November).

Table 4 further characterizes age, sex and season as sources of variation in dietary intake by comparing age and sex differences in food intake (classified in food groups) for the subset of nine communities surveyed in both seasons. Market food use showed no significant seasonal variation, whereas traditional food did for fish; the intake of land animals remained stable. Berries and bird consumption did not vary by season of interview because intakes during these seasons were minimal. Both bird hunting and berry picking (as well as other plant gathering) are activities limited to a short time window in spring and summer, respectively, two seasons not included in this data set. Besides season, sex and age effects were present as well as age × sex interactions. Adjusting for age, women compared with men tended to derive less of their dietary energy from market meat and more from grains with these differences becoming more marked in older generations. Although intakes of other food groups were similar for younger men and women, differences appeared with increasing age. Older generations consumed less of dairy products, fruits and vegetables, and mixed dishes and more traditional fish and land animals. Other age-related effects were peculiar to the oldest group and included higher grains and lower fat and sweet intakes among older women, compared with men of the same age. Table 4 also shows how market meats were substituted for traditional land animals among younger generations.

In addition to age, sex and seasonal variation, geographical variation is important (**Fig. 2**). In some communities, traditional food constitutes a greater percentage of total energy intake than in others. It appears that more northern communities derived a larger proportion of dietary energy from traditional food. Differences in traditional food intake among communities may be related to community characteristics such as population size, road access and availability of affordable market food, proximity to animal migration routes, and prevalent fishing and hunting practices. Of particular interest is how differences in traditional food use are likely to be reflected in differences in diet quality and nutrient intakes.

***Traditional food and diet quality*.** **Table 5** shows how nutrient intakes vary by overall level of traditional food use in

TABLE 4

Percent of total energy intake from market and traditional food groups, by sex and age for nine Dene and Métis communities interviewed in both seasons (n = 723)[1]

	Market food groups[2]							Traditional food groups[2]			
	Dairy	Fruits and vegetables	Grains	Meat alternates	Meat	Mixed dishes	Sweet and fat	Berries	Birds	Fish	Land animals
						%					
Women											
20–40 y	5.8 ± 0.5	9.5 ± 0.7	18.3 ± 0.9	4.1 ± 0.5	16.6 ± 1.1	8.3 ± 1.0	26.1 ± 1.0	0	0.3 ± 0.2	0.9 ± 0.3	10.2 ± 1.0
41–60 y	4.8 ± 0.5	8.3 ± 0.8	22.4 ± 1.4	3.9 ± 0.6	10.7 ± 1.5	4.4 ± 0.8	19.4 ± 1.2	0.1 ± 0.1	1.1 ± 0.7	5.0 ± 1.1	20.0 ± 1.9
61+ y	3.2 ± 0.6	7.4 ± 1.0	26.7 ± 1.8	3.2 ± 0.5	9.4 ± 1.7	3.5 ± 0.9	16.2 ± 1.4	0.03 ± 0.03	0.4 ± 0.3	4.8 ± 1.1	24.7 ± 2.7
Males											
20–40 y	4.3 ± 0.4	8.8 ± 0.7	18.3 ± 1.0	5.1 ± 0.7	16.5 ± 1.2	6.1 ± 0.8	24.0 ± 1.0	0	0.4 ± 0.2	2.3 ± 0.5	13.3 ± 1.1
41–60 y	4.6 ± 0.9	8.9 ± 1.3	20.6 ± 1.4	4.4 ± 0.5	15.0 ± 1.4	3.8 ± 0.8	20.2 ± 1.1	0	0	4.4 ± 0.9	18.1 ± 1.8
61+ y	2.6 ± 0.4	4.4 ± 0.7	20.1 ± 1.9	4.6 ± 0.6	13.5 ± 2.0	3.5 ± 0.9	22.9 ± 1.8	0.03 ± 0.03	0.2 ± 0.2	5.9 ± 1.3	22.4 ± 2.6
Significant main effects (*P* value) from ANOVA model: % energy = season, sex, age, sex × age											
Season	NS[3]	NS	NS	NS	NS	NS	NS	NS	NS	0.009	NS
Sex	NS	NS	0.008	NS	0.01	NS	NS	NS	NS	NS	NS
Age	0.004	0.004	0.0002	NS	0.0003	0.0002	0.0001	NS	NS	0.0001	0.0001
Sex × age	NS	NS	0.03	NS	NS	NS	0.003	NS	NS	NS	NS

[1] Values are means ± SEM for fall and late winter combined.
[2] Ten main food items from each food group (based on the percentage of total energy contribution).

Market food groups:

Dairy: Milk (2% fat), coffee whitener powder, milk (evaporated canned), soup (cream of chicken with milk), cheese cheddar, cheese (processed), ice cream, milk whole, cream cheese, pudding from mix with milk.

Fruits and vegetables: Potatoes, fried potatoes, apple, grape or prune juice, raw apple, tomato soup, sweet corn (white and yellow), orange juice, raw orange, raw banana, mixed frozen vegetables.

Grains: white bread, bannock, white rice, assorted cookies, spaghetti, rolled oats or oatmeal, saltine crackers, whole wheat bread, wheat flakes, corn flakes.

Meat alternates: eggs, peanuts (all types), gravy brown meat, white boiled beans, beans (baked, canned), peanut butter, beans (kidney, canned), soup beef broth or bouillon.

Meat: chicken, beef hamburger, frankfurters, pork (lean cuts), bacon, beef (round broiled), beef (chuck blade roast), pork sausage, turkey, beef (corned, canned).

Mixed dishes: macaroni and cheese, chicken noodle soup, canned hash corned beef, soup (vegetables and beef), frozen fried chicken dinner, pizza with cheese, spaghetti with meat balls and tomatoes, spaghetti in tomato sauce, chicken chow mein.

Sweet and fat: white sugar, lard, fruit ades, butter, soft drinks, potato chips, margarine, chocolate plain milk, corn oil, mayonnaise.

Traditional food groups:

Berries: cranberries, blueberries.

Birds: surf scoter and white-winged scoter flesh and fat, swan flesh, ptarmigan flesh, fisher duck flesh, sharp-tailed grouse flesh, Canada goose flesh, spruce hen flesh.

Fish: whitefish flesh, trout flesh, cisco flesh, loche flesh, cisco flesh (smoked/dried), whitefish flesh (smoked/dried), loche liver, inconnue flesh, arctic char flesh, loche eggs.

Land animals: caribou meat, moose meat, caribou meat (dried), caribou fat, caribou ribs, moose meat (dried), moose ribs, moose fat, muskrat meat, caribou tongue.

[3] NS = not significant ($P > 0.05$).

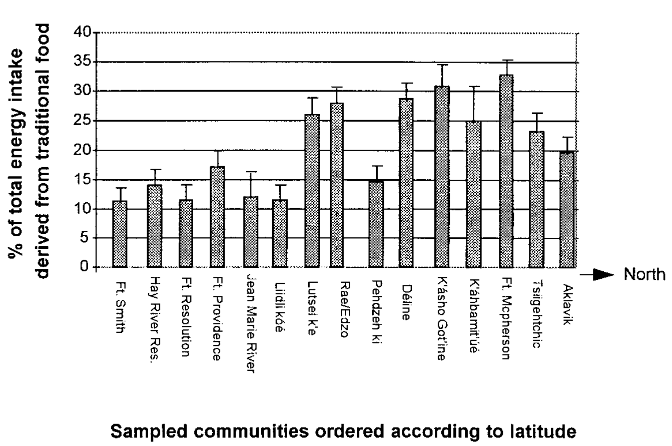

FIGURE 2 Geographical variation in the percentage of the contribution of traditional food to total energy intake in fall 1994 ($n = 656$). Values are least square means and SEM adjusted for age and sex.

the community. A community was defined as a high traditional food user if more than 20% of total dietary energy was derived from the traditional food system and as a low traditional food user otherwise (see Fig. 2 for community classification). Differences in intake were tested after adjusting for age and sex differences. Communities classified as low traditional food users consumed a smaller absolute amount of traditional food but more total energy, in particular from carbohydrate (specifically sucrose), total fat and saturated fat. In this group of communities, calcium and vitamin A intakes were significantly higher than in communities where traditional food was more utilized; however, intakes remained below Canadian Recommended Nutrients Intakes (RNI), which are 700–800 mg of calcium and 800–1000 retinol equivalents of vitamin A for adults over 18 y of age (Health and Welfare Canada 1990). Intake of dietary fiber was greater in communities with lower traditional food use, but overall intake remained low. Average iron, zinc and magnesium intakes, albeit different in the two community groups, were adequate in all cases relative to RNI.

Whereas Table 5 provided a description of the nutrient

TABLE 5

Average daily food weight, energy, nutrient, fiber and sucrose intakes in Dene and Métis communities with high and low traditional food use (TFU), by sex and age for fall 1994[1,2]

		Age 20–40 y		Age 41–60 y		Age 61+ y		
		High TFU (*n* = 78 M, 87 F)	Low TFU (*n* = 87 M, F = 109)	High TFU (*n* = 49 M, 44 F)	Low TFU (*n* = 56 M, 39 F)	High TFU (*n* = 32 M, 31 F)	Low TLU (*n* = 26 M, 18 F)	Community main effect *P* value[3]
Traditional food, *g*	M	278 ± 33	134 ± 20	460 ± 50	188 ± 36	528 ± 62	259 ± 52	0.0001
	F	184 ± 23	70 ± 13	420 ± 44	195 ± 37	410 ± 57	202 ± 55	
Energy, *kJ*	M	9134 ± 347	10,548 ± 435	10,690 ± 586	10,782 ± 682	7996 ± 510	9083 ± 808	0.02
	F	7899 ± 285	8632 ± 351	8146 ± 473	9025 ± 552	6979 ± 494	7694 ± 854	
Carbohydrate, *g*	M	211 ± 10	265 ± 14	210 ± 15	244 ± 19	151 ± 16	198 ± 23	0.0001
	F	198 ± 11	235 ± 10	169 ± 11	218 ± 17	145 ± 14	190 ± 21	
Protein, *g*	M	140 ± 8	128 ± 6	197 ± 13	154 ± 11	175 ± 14	146 ± 14	0.0001
	F	113 ± 6	98 ± 5	157 ± 11	130 ± 11	153 ± 17	115 ± 13	
Fat, *g*	M	86 ± 5	106 ± 6	99 ± 9	108 ± 9	63 ± 6	86 ± 10	0.0001
	F	71 ± 4	83 ± 5	69 ± 9	84 ± 7	48 ± 6	67 ± 10	
Saturated fat, *g*	M	30 ± 2	38 ± 2	32 ± 2	40 ± 4	21 ± 2	30 ± 4	0.001
	F	25 ± 1	30 ± 2	23 ± 3	30 ± 3	14 ± 2	23 ± 4	
Polyunsaturated fat, *g*	M	15 ± 1	19 ± 1	18 ± 3	17 ± 2	14 ± 2	14 ± 2	0.001
	F	12 ± 1	15 ± 1	11 ± 1	18 ± 2	10 ± 2	14 ± 3	
Vitamin A,[4] *RE*	M	389 (315–482)	521 (414–656)	470 (316–701)	400 (293–547)	130 (72–233)	243 (123–480)	0.0001
	F	345 (283–421)	475 (404–560)	210 (128–345)	458 (354–591)	117 (66–205)	356 (199–638)	
Iron, *mg*	M	21 ± 1	20 ± 1	28 ± 3	23 ± 2	22 ± 2	23 ± 3	0.007
	F	18 ± 1	15 ± 1	24 ± 2	21 ± 2	32 ± 10	19 ± 3	
Zinc, *mg*	M	19 ± 1	18 ± 1	26 ± 2	27 ± 4	21 ± 2	18 ± 2	0.02
	F	16 ± 1	17 ± 4	21 ± 2	26 ± 6	19 ± 3	14 ± 2	
Copper, *mg*	M	1.5 ± 0.1	1.4 ± 0.1	2.1 ± 0.3	1.8 ± 0.2	1.5 ± 0.1	1.6 ± 0.2	NS
	F	1.2 ± 0.1	1.3 ± 0.2	1.8 ± 0.2	1.6 ± 0.3	1.5 ± 0.2	1.2 ± 0.1	
Calcium, *mg*	M	503 ± 40	674 ± 58	535 ± 51	619 ± 59	431 ± 55	476 ± 53	0.0002
	F	403 ± 26	600 ± 48	451 ± 45	605 ± 64	426 ± 50	483 ± 63	
Magnesium, *mg*	M	272 ± 12	285 ± 11	322 ± 116	318 ± 19	280 ± 18	281 ± 26	NS
	F	240 ± 9	247 ± 10	294 ± 15	268 ± 14	257 ± 22	246 ± 24	
Phosphorus, *mg*	M	1542 ± 78	1530 ± 70	2055 ± 115	1662 ± 114	1838 ± 138	1546 ± 143	0.01
	F	1253 ± 56	1240 ± 60	1699 ± 104	1529 ± 104	1617 ± 171	1361 ± 162	
Sodium, *mg*	M	2793 ± 180	3376 ± 254	2881 ± 270	3352 ± 273	2354 ± 271	2942 ± 313	0.0001
	F	2438 ± 153	2926 ± 165	2038 ± 207	3267 ± 271	2045 ± 183	2324 ± 253	
Potassium, *mg*	M	3045 ± 154	3119 ± 128	3813 ± 205	3550 ± 221	3213 ± 251	2904 ± 309	NS
	F	2708 ± 106	2744 ± 125	3363 ± 163	3014 ± 197	2753 ± 293	2578 ± 322	
Dietary fiber, *g*	M	14 ± 1	18 ± 1	13 ± 1	18 ± 1	9 ± 1	14 ± 2	0.0001
	F	14 ± 1	16 ± 1	11 ± 1	16 ± 1	8 ± 1	13 ± 1	
Sucrose, *g*	M	60 ± 4	79 ± 6	53 ± 5	63 ± 8	38 ± 6	41 ± 5	0.001
	F	64 ± 6	68 ± 4	48 ± 7	55 ± 6	28 ± 5	48 ± 7	

1 Values are means ± SEM.
2 Communities are classified as high traditional food use (TFU) if energy intake from traditional food is greater than 20% of total energy intake, and as low TFU otherwise.
3 Significant community effect based on Kruskal-Wallis nonparametric ANOVA adjusting for age and sex effects. NS = not significant ($P > 0.05$).
4 Geometric means and 95% confidence intervals. RE = retinol equivalents.

implications of the observed variation in traditional and market food use across communities, **Tables 6–8** illustrate the current extremes on the continuum of dietary change. Comparison of food records with market food only or with a mix of traditional and market food shows how, when market food only was consumed, the macronutrient profile shifted towards higher carbohydrate (and sucrose in particular for women), fat and saturated fat. Records without traditional food were lower in protein, iron, zinc, copper, magnesium and phosphorus, nutrients found in great quantity in wild meats. Food records without traditional food were also higher in sodium. Sodium values represent content in food and exclude the sodium added at the table. Whether traditional food was consumed or not, vitamin A and calcium intakes remained low, suggesting that traditional food sources rich in these nutrients—such as caribou, moose or fish liver (vitamin A), soups or stews cooked with bones, and fish with small bones and skin (calcium)—may not be consumed in sufficient amounts to make a difference. Similarly, dietary fiber intake remained low when market food only was consumed.

Analyzing the intakes of additional nutrients for which food composition data exist for market food but not for traditional food suggests that vitamin D, vitamin E and folic acid intakes may also be of concern when market food only is consumed (Table 8). Although additional vitamin D and vitamin E may be provided by traditional food, folic acid intake is unlikely to improve when traditional food is consumed, unless liver is often used.

DISCUSSION

This analysis extended to a large number of Dene/Métis communities what had previously been reported in only a selected few communities. Calcium and vitamin A have been previously reported at risk of inadequate intake in two Sahtú communities (Kuhnlein et al. 1995a) and one South-Slave

TABLE 6

Percentage of energy contributed by carbohydrate, protein and fat on days with and without traditional food intake in Dene and Métis communities[1]

Energy source		Days with traditional food (n = 336 M, 326 F)	Days without traditional food (n = 165 M, 185 F)
		%	
Carbohydrate	M	34 ± 1*	39 ± 1
	F	38 ± 1*	44 ± 1
Sucrose	M	9 ± 1	11 ± 1
	F	9 ± 1*	13 ± 1
Protein	M	32 ± 1*	21 ± 1
	F	30 ± 1*	19 ± 1
Fat	M	34 ± 1*	39 ± 1
	F	31 ± 1*	37 ± 1
Saturated fat	M	12 ± 0.3*	14 ± 0.4
	F	11 ± 0.3*	13 ± 0.3
Polyunsaturated fat	M	6 ± 0.2	6 ± 0.3
	F	6 ± 0.2	7 ± 0.3

[1] Values are least square means ± SEM adjusting for varying community sample size, season and age group. M = male, F = female. * Significant difference ($P < 0.05$) between days with and days without traditional food, within each sex, based on Kruskal-Wallis nonparametric ANOVA controlling for the effects of varying community sample size, season and age group.

community (Wein et al. 1991a). In Wein et al. (1991a), folate and vitamin D intakes were also identified at risk, as well as iron (in middle adult females) and vitamin C (for men). We confirmed folate to be at risk for some in Dene/Métis communities. In all age and sex groups, however, vitamin C intake seemed adequate, and iron intake was high considering its probable high bioavailability. Vitamin D and E nutriture seemed inadequate when diet was exclusively composed of market food. However, traditional food is likely to contribute significant amounts of these two nutrients. Currently there are insufficient published values for vitamins E and D in traditional food, making it difficult to estimate these nutrients in the diet. Finally, dietary fiber intake was uniformly low across all age and sex groups.

Macronutrient profiles of the diets were similar to those reported for the Dogrib Dene/Métis (Ritenbaugh et al. 1995, Szathmary et al. 1987) and Sahtú Dene/Métis (Kuhnlein et al. 1995a). Wein and co-workers reported a lower contribution of protein and a higher dietary fiber intake in their study of Fort Smith residents (Wein et al. 1991a). These different dietary components suggest that the latter population did not consume as much traditional food as other Dene/Métis communities. In our study as well, the most southern community (Fort Smith) was identified as a low traditional food user compared with other Dene/Métis communities (Fig. 2).

Although previous work documented the importance of considering age, sex and food type (traditional vs. market) as sources of variation in dietary intake among Dene/Métis (Kuhnlein et al. 1995a, Morrison et al. 1995, Szathmary et al. 1987, Wein et al. 1991a), limited information has been reported on between-community variation in dietary intake (Morrison et al. 1995, Ritenbaugh et al. 1995). The study of variation in diet among age groups and among communities offers an opportunity to use cross-sectional data to characterize the process of dietary change. This methodology may be particularly appropriate to the study of indigenous peoples in rapid transition, because collection of time-trend data of the required magnitude to detect dietary change is often not feasible. For indigenous peoples who formerly relied entirely on locally harvested products, the percentage of market food now included in the diet can act as an indicator of change. Comparing nutrient intakes on days with or without traditional food further illustrates how nutrient intake can be maximally affected in the transition.

The need for a better understanding of the process of dietary change has, however, been emphasized in relation to ecological, economic and cultural factors responsible for loss of traditional systems around the world (Johns et al. 1994) and potential implications such as loss of culture-specific knowledge, increase in sedentary lifestyle and diet-related chronic health conditions (Kuhnlein and Receveur 1996).

For the Dene/Métis, this shift away from traditional food use is characterized by an increase in absolute energy intake and increases in the relative contributions of carbohydrate (particularly sucrose), fat and saturated fat. These changes alone are likely to have significant negative effects on the health of the population. Other implications for health include overall low intakes of calcium, vitamin A, folate and dietary fiber.

When patterns and consequences of dietary change for indigenous peoples were reviewed, Kuhnlein and Receveur (1996) concluded that negative nutritional status consequent to loss of a traditional food system can be countered under certain conditions such as adequate income, availability of good-quality market food, and education in the use of the new market food. It is our opinion that none of these conditions are met for the great majority of Dene/Métis.

TABLE 7

Average vitamin A, minerals and fiber intakes on days with and without traditional food intake in Dene and Métis communities[1]

		Days with traditional food (n = 336 M, 326 F)	Days without traditional food (n = 165 M, 185 F)
Vitamin A[2], *RE*	M	257 (216–306)	280 (220–355)
	F	304 (258–358)	321 (254–405)
Iron, *mg*	M	28 ± 1*	15 ± 1
	F	25 ± 1*	15 ± 2
Zinc, *mg*	M	25 ± 1*	15 ± 1
	F	20 ± 2*	15 ± 2
Copper, *mg*	M	1.9 ± 0.1*	1.2 ± 0.1
	F	1.8 ± 0.1*	1.4 ± 0.2
Calcium, *mg*	M	520 ± 25	498 ± 34
	F	499 ± 22	539 ± 32
Magnesium, *mg*	M	325 ± 7*	241 ± 10
	F	284 ± 7*	236 ± 10
Phosphorus, *mg*	M	1932 ± 45*	1270 ± 61
	F	1647 ± 41*	1237 ± 59
Sodium, *mg*	M	2982 ± 125*	3354 ± 171
	F	2706 ± 111*	3022 ± 159
Potassium, *mg*	M	3741 ± 87*	2565 ± 118
	F	3192 ± 84*	2590 ± 119
Dietary fiber, *g*	M	15 ± 1	14 ± 1
	F	13 ± 1	13 ± 1

[1] Values are least square means ± SEM adjusting for varying community sample size, season and age group. M = male, F = female. * Significant difference ($P < 0.05$) between days with and days without traditional food, within each sex, based on Kruskal-Wallis nonparametric ANOVA controlling for the effects of community sample size, season and age group.

[2] Geometric least square means with 95% confidence intervals. RE = retinol equivalents.

TABLE 8

Average micronutrient intake in Dene and Métis communities on days without traditional food for nutrients with only market food composition data[1]

		Days without traditional food (n = 165 M, 185 F)
Vitamin D, *μg*	M	2.6 ± 0.3
	F	2.2 ± 0.4
Vitamin E, *mg*	M	5 ± 0.3
	F	4 ± 0.4
Vitamin C, *mg*	M	72 ± 12
	F	97 ± 12
Folic acid, *μg*	M	160 ± 10
	F	149 ± 11
Niacin, *mg*	M	27 ± 1
	F	23 ± 1
Thiamin, *mg*	M	1.5 ± 0.1
	F	1.4 ± 0.1
Riboflavin, *mg*	M	1.6 ± 0.1
	F	1.4 ± 0.1
Pantothenic acid, *μg*	M	5180 ± 246
	F	4434 ± 257
Vitamin B-6, *μg*	M	1718 ± 92
	F	1616 ± 96
Vitamin B-12, *μg*	M	4.8 ± 0.8
	F	4.8 ± 0.8

[1] Values are least square means ± SEM adjusting for varying community sample size, season and age group. M = male, F = female.

Our work showed that the Dene/Métis traditional food system is still used extensively but that there is a trend for decreasing use in the younger generation and that some communities rely less on their traditional food system than others. This pattern of change calls for initiatives to document the current health status of this population and to prevent potential negative health consequences.

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