DIETARY NUTRIENTS AND ANTHROPOMETRY OF DENE/MÉTIS AND YUKON CHILDREN

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Received 26 July 2004, Accepted 26 January 2005

ABSTRACT

Objective. To describe nutrient intakes and anthropometry of 10-12-year-old Dene/Métis and Yukon children in the Canadian Arctic.

Study design. 24h-recall interviews (n = 222 interviews) were conducted on Canadian Dene/Métis and Yukon children in five communities during two seasons in 2000 – 2001; the children were measured for height and weight (n = 216).

Methods. Assessment of nutrient adequacy used Dietary Reference Intakes (DRIs) including cut-point procedures. Anthropometric measurements (height and weight) were assessed and body mass index (BMI) was compared to the 2000 CDC Growth Charts.

Results. Thirty-two percent of the children were above the 85th percentile of BMI-for-age. More than 50 percent of children were below the Estimated Average Requirement (EAR) for vitamins A and E, phosphorus and magnesium; mean intakes were below the Adequate Intake (AI) for vitamin D, calcium, dietary fiber, omega-6 fatty acids, and omega-3 fatty acids. Nutrients that were probably adequate for some gender/season groups were protein, carbohydrate, iron, copper, selenium, zinc, manganese, riboflavin and vitamins B6 and C.

Conclusions. Excessive prevalence of overweight and inadequacy of some nutrients were observed among Dene/Métis and Yukon children, suggesting a necessity for dietary improvement. However, many nutrients were adequate, in some cases probably due to continued traditional food use. (Int J Circumpolar Health 2005;64(2):147-156.)

Key words: Indigenous people, arctic children, nutrient intake, anthropometry
INTRODUCTION

Dietary inadequacies for several nutrients and high fat and sugar intakes have been reported among indigenous peoples in the Canadian Arctic and Subarctic. Studies of nutrient intakes in two Sahtu Dene/Métis communities (Northwest Territories) reported low intakes of vitamin A and calcium, and more than 28 percent of energy came from fat, with 9 percent from saturated fat (1). More extensive research conducted with Dene/Métis adults in 16 communities examined nutrient intakes, showing that low intakes of vitamin A, calcium, folate and dietary fiber were prominent (2). In the Yukon Territory, nutrient intake studies of adults in four First Nations communities showed low intakes of folate, calcium, vitamin A, vitamin D, vitamin C and zinc in the population, and more than 36 percent of energy was derived from fat and 13 percent from saturated fat (3). Cree and Chipewyan peoples and Métis in Northern Alberta were reported to have low intakes of vitamin A, vitamin D, vitamin C and zinc; also reported among children were high sugar intakes and more than 33 percent of dietary energy came from fat and 12 percent from saturated fat (4, 5).

Excessive overweight has been reported among Canadian children (6, 7) and in three studies of Southern Canadian Indigenous children from Mohawk, Cree and Ojicree heritage (8-11). When compared with National Health and Nutrition Examination Surveys (NHANES II, or III) reference populations, 28-38 percent of these school children exceeded the BMI percentiles for overweight (85 percent, or 90 percent). This excessive overweight reported among Canadian Indigenous children agreed with results of anthropometric measures conducted on Native American schoolchildren (12-15). Thus, concern developed for Dene/Métis and Yukon children living in the Canadian Arctic, where traditional diets and physical activity are thought to promote healthy lifestyles, but an erosion of these practices is known to be occurring rapidly (16, 17).

Children were studied in 2000 – 2001 in five Dene/Métis and Yukon communities: Fort McPherson, Tulita, Fort Resolution in the Northwest Territories, and Old Crow and Carcross in Yukon Territory (see map in preceding paper, ref 18). The primary objective was to better understand children’s anthropometry and nutrition. This report emphasizes dietary nutrients and anthropometry, and the accompanying paper (18) reports food use and nutrient differences among children reporting to have consumed, or not consumed, traditional food (TF) in the different regions.

METHODS

Five communities were selected by the Council of Yukon First Nations (CYFN) and the Dene Nation to represent women and children in the approximately 30 communities of Yukon First Nations and Dene/Métis within the available budget. The project was approved by the McGill University Human Ethics Committee. Research agreements with all communities were made and science licenses were obtained from the Territorial authorities. Parents were contacted through schools and signed parental consent was obtained for children to participate.
in the study. Additional data collected on women’s food choice decisions will be reported separately.

Dietary 24h-recall interviews and anthropometric measurements were conducted with children 10 to 12 years of age during two interview seasons: season 1 (November to January, 2000-2001) and season 2 (August to October, 2001). The recall interviews were conducted (total n = 222 interviews), and height and weight measurements were taken (n = 216); approximately 84 percent of children (n = 187) gave repeat recalls (35 children gave a single recall), of which 66 percent were conducted on consecutive days and 34 percent were on non-consecutive days. All children in the communities were asked to participate in both seasons, and the participation rate for 24h-recalls was 81 percent. However, identities were not retained and prevented knowing exactly which children participated in both seasons. In season 1, 62 girls and 43 boys participated, and 66 girls and 51 boys participated in season 2. Details of dietary interview methods are given in the accompanying paper (18).

Children were measured for height and weight without shoes and in light indoor clothing (no jackets or sweaters) (19, 20). Weight was measured using an electronic digital scale (Model Seca 770; Germany) to the nearest 0.1 kg. Height was measured using a height measuring board (Shorr Productions, Irwin J. Shorr, Olney, Maryland) to the nearest 0.1 cm. Anthropometric records were coded and entered within the NutStats program of Epi Info, and data were carefully checked at data entry. The 2000 CDC Growth Charts were used as reference for the anthropometric measurements (21, 22). BMI-for-age was used to assess physical growth and to determine the prevalence of overweight and underweight of the children. A BMI ≥ 95th percentile was considered overweight, 95th > BMI ≥ 85th percentile at risk of overweight, and BMI < 5th percentile as underweight.

The Dietary References Intakes (DRIs) were used to describe the adequacy of nutrient intakes (23). Only food intake was used to estimate dietary nutrients, since information on supplement use (reported for roughly 25 percent of children) was not sufficiently detailed to incorporate into this study. The Estimated Average Requirement (EAR) cut-point method, which is a simpler version of the probability approach, was used to assess the adequacy of nutrient intake (23). The NRC method (24) was used for estimating the usual intake distribution of a nutrient. Data from individuals giving 2 recalls on non-consecutive days were used to calculate the adjustment for each nutrient; this factor was then applied to the first recall of all children within a season, including those children who only contributed one recall. In some cases, inter-individual variation was zero, probably due to small sample sizes, which prevented applying the formula. This is noted in the results tables.

To summarize dietary adequacy, we estimated intakes as "probably inadequate" if the intake of a nutrient for 50 percent of the population fell below the EAR, or if the mean intake was below the Adequate Intake (AI). "Possibly adequate" was assumed if 10 - 50 percent of intakes were below the EAR, and "probably adequate" was assumed if < 10 percent of the population intakes fell below the EAR, or the mean intake exceeded the AI (23, 26, 27). Although this use of AI data is not
recommended by the DRI procedures (23, 26, 27), we consider it a modest assumption in this case to capture the concern for low intakes of AI nutrients. We recognize that mean intakes below the AI cannot be clearly interpreted as inadequate intakes for these children.

RESULTS AND DISCUSSION

Anthropometry

Table I shows the percent of Dene/Métis and Yukon children in the underweight, normal weight, risk of overweight, and overweight categories of the 2000 CDC Growth Charts. In both seasons, underweight was less prevalent, and risks of overweight, and especially overweight, were more prevalent than in the reference population. The percent of overweight children was similar for girls and boys. The anthropometric data show no evidence of undernutrition in Dene/Métis and Yukon children. However, encroaching overweight and obesity is a concern. Over the two-season period, 32 percent of Dene/Métis and Yukon children were above the 85th percentile of the 2000 CDC reference, which is similar to results from previous studies with other Canadian Indigenous children (8-11). Compared to all-Canadian children, a greater proportion of children in this study exceeded the standard for excessive BMI (> 95% of standard). Tremblay and Willms (6) reported a more than two-fold increase of BMIs categorized above the 85th or 95th percentiles since 1981 for Canadian children. 13.5 percent and 11.8% of all-Canadian boys and girls, respectively, now exceed the 95th percentile, while data reported here for Dene/Métis and Yukon children (using similar CDC standards) were approximately 18% for both boys and girls in this same category (Table I).

Considering our current understanding of obesity in a population, further data on physical activity and other leisure time habits in these communities may be helpful. Several studies have reported that low levels of physical activity and high levels of television viewing were associated with obesity (8, 11, 28, 29).

|                | Season 1 (n = 102) | Season 2 (n = 114) |
|----------------|--------------------|--------------------|
|                | Girls (n = 62)     | Boys (n = 40)      | Total (n = 102) | Girls (n = 63) | Boys (n = 51) | Total (n = 114) |
| Underweight    | 2                  | 3                  | 2               | 2               | 2               | 2               |
| Normal weight  | 65                 | 70                 | 67              | 65               | 71              | 68              |
| Risk of overweight | 16               | 8                  | 13              | 16               | 10              | 13              |
| Overweight     | 18                 | 20                 | 19              | 18               | 18              | 18              |

1 BMI-for-age < 5th percentile
2 5th ≤ BMI-for-age < 85th percentile
3 95th > BMI-for-age ≥ 85th percentile
4 BMI-for-age ≥ 95th percentile
Season 1 is November – January and Season 2 August – October.
### Table II. Median usual nutrient intakes by Dene/Métis and Yukon girls of 10-12 years of age, DRIs and percentage below EAR 1.

| Nutrient      | EAR (mg) | RDA 2 (mg) | Median (25th, 75th percentiles) | Percentage < EAR |
|---------------|----------|------------|---------------------------------|-----------------|
|               |          |            | Season 1 (n = 62)               | Season 2 (n = 66) | Season 1 | Season 2 |
| Energy        | NA       | -          | 1707 (1443, 2210)               | 1682 (1412, 1966) | -         | -         |
| Carbohydrate  | 100      | 130        | 235 (182, 301)                  | 237 (202, 279)   | 3.0       | 0.0       |
| Protein       | 0.76     | 0.95       | 1.5 (1.1, 2.1)                  | 1.4 (1.0, 2.0)   | 8.1       | 23        |
| Iron          | 5.7      | 8.0        | 14 (12, 17)                     | 13 (10, 15)      | 0.0       | 0.0       |
| Zinc          | 7.0      | 8.0        | 9.7 (8.8, 11)                   | 8.4 (6.3, 9.7)   | 4.8       | 35        |
| Copper        | 540      | 700        | 1062 (945, 1355)                | 1045 (850, 1298) | 0.0       | 1.5       |
| Magnesium     | 200      | 240        | 202 (150, 247)                  | 173 (145, 220)   | 48        | 71        |
| Phosphorus    | 1055     | 1250       | 955 (793, 1192)                 | 890 (650, 1166)  | 65        | 70        |
| Selenium      | 35       | 40         | 65 (49, 88)                     | 70 (56, 86)      | -5        | 0.0       |
| Vitamin A     | 420      | 600        | 397 (271, 625)                  | 387 (295, 478)   | -5        | 62        |
| Vitamin E     | 9        | 11         | 3.1 (2.4, 4.2)                  | 2.8 (2.1, 3.4)   | 100       | 100       |
| Vitamin C     | 39       | 45         | 117 (69, 152)                   | 100 (52, 150)    | 8.1       | 17        |
| Folate        | 250      | 300        | 277 (182, 453)                  | 310 (228, 408)   | -5        | 32        |
| Riboflavin    | 0.8      | 0.9        | 1.3 (1.1, 1.7)                  | 1.2 (1.0, 1.6)   | 11        | 6.1       |
| Vitamin B6    | 0.8      | 1.0        | 1.9 (1.2, 2.4)                  | 1.5 (1.2, 1.9)   | 8.1       | 4.6       |

1 EAR = Estimated Average Requirement.
2 RDA = Recommended Dietary Allowance.
3 α-tocopherol.
4 Intakes are not adjusted to usual intakes (Zero was given for the inter-individual variation).
5 Calculations are not performed, because intakes are not adjusted to usual intakes.
6 Season 1 is November – January and Season 2 August – October.

### Table III. Median usual nutrient intakes by Dene/Métis and Yukon boys of 10-12 years of age, DRIs and percentage below EAR 1.

| Nutrient      | EAR (mg) | RDA 2 (mg) | Median (25th, 75th percentiles) | Percentage < EAR |
|---------------|----------|------------|---------------------------------|-----------------|
|               |          |            | Season 1 (n = 62)               | Season 2 (n = 66) | Season 1 | Season 2 |
| Energy        | NA       | -          | 1805 (1561, 2242)               | 1999 (1655, 2381) | -         | -         |
| Carbohydrate  | 100      | 130        | 221 (195, 321)                  | 283 (254, 320)   | 0.0       | 0.0       |
| Protein       | 0.76     | 0.95       | 1.7 (1.2, 2.2)                  | 1.6 (1.4, 2.0)   | -5        | 0.0       |
| Iron          | 5.9      | 8.0        | 15 (13, 16)                     | 17 (14, 20)      | 0.0       | 0.0       |
| Zinc          | 7.0      | 8.0        | 9.0 (7.1, 12)                   | 9.3 (7.2, 12)    | -5        | 22        |
| Copper        | 540      | 700        | 1108 (928, 1308)                | 1272 (1010, 1545) | 0.0       | 0.0       |
| Magnesium     | 200      | 240        | 207 (170, 230)                  | 205 (163, 265)   | 40        | 45        |
| Phosphorus    | 1055     | 1250       | 1084 (996, 1222)                | 1034 (872, 1380) | 44        | 55        |
| Selenium      | 35       | 40         | 69 (50, 91)                     | 76 (54, 95)      | -5        | 7.8       |
| Vitamin A     | 445      | 600        | 432 (279, 580)                  | 411 (295, 512)   | -5        | 65        |
| Vitamin E     | 9        | 11         | 1.0 (0.8, 1.2)                  | 3.3 (2.0, 4.6)   | 100       | 100       |
| Vitamin C     | 39       | 45         | 89 (52, 136)                    | 114 (62, 166)    | 4.7       | 5.9       |
| Folate        | 250      | 300        | 295 (183, 422)                  | 329 (240, 455)   | -5        | 29        |
| Riboflavin    | 0.8      | 0.9        | 1.4 (1.1, 1.7)                  | 1.5 (1.3, 1.7)   | 0.0       | 0.0       |
| Vitamin B6    | 0.8      | 1.0        | 1.9 (1.5, 2.4)                  | 1.9 (1.6, 2.3)   | 4.7       | 0.0       |

1 EAR = Estimated Average Requirement.
2 RDA = Recommended Dietary Allowance.
3 α-tocopherol.
4 Intakes are not adjusted to usual intakes (Zero was given for the inter-individual variation).
5 Calculations are not performed, because intakes are not adjusted to usual intakes.
6 Season 1 is November – January and Season 2 August – October.
Adequacy of nutrient intake

Tables II and III show median usual nutrient intakes by Dene/Métis and Yukon girls and boys, respectively, of 10-12 years of age, the DRIs, and the percentages below the EAR. Table IV presents mean usual nutrient intakes and the AI. Twenty nutrients were compared to the DRI values.

Although anthropometric data showed high prevalence of obesity, excessive energy intake was not observed (Tables I, II and III). Compared to other studies on the dietary intake of similarly aged children, the reported energy intakes of Dene/Métis and Yukon children were not remarkably low. Indigenous school children of 8 to 15 years of age in Northern Alberta reported mean energy intakes of 1750 kcal for girls and 2079 kcal for boys (5). Studies with Mohawk children of 10 to 12 years of age reported mean energy intakes of 2212 kcal for girls and 2166 kcal for boys in 1994 (30), and of 2100 kcal for girls and 2202 kcal for boys in 1998 (31). The study with US children in the 1994 to 1996 Continuing Survey of Food Intake by Individuals (CSFII) (32) reported median usual intakes of 1854 kcal for girls and 2199 kcal for boys of 9 - 13 years of age. Mean Estimated Energy Requirements (EER) have been estimated for use in the absence of physical activity data, and also in consideration of a possible bias in the under-estimation of energy intakes (33-37). Using the EER for the data reported here, physical activity levels fell within reasonable levels estimated as "sedentary" to "low active."

Table V summarizes the results of nutrient intakes of children from the diet, taking gender and season into account. Nine nutrients were categorized into the "probably inadequate" group. More than 50 percent of children had intakes below the EAR for magnesium, phosphorus, vitamin A and, especially, vitamin E. Mean values of calcium, vitamin D, dietary fiber, omega-6 fatty acids and omega-3 fatty acids were below the AI for girls and boys in both seasons. On a more positive note, less...
than 10 percent of children in some gender/season groups had intakes below the EAR for carbohydrate, protein, iron, copper, vitamin C, riboflavin, vitamin B6, selenium and zinc. These nutrients exceeded the RDA, even at the 25th percentile of intake. The mean value of manganese exceeded the AI.

Of 20 nutrients from the diet, more than half were found to be probably inadequate or only possibly adequate compared to the DRI values, suggesting the necessity for dietary improvements. Even if nutrient intakes from supplements could be incorporated, several nutrients in the “probably inadequate” group would likely remain low, because of the very low estimated intakes. Vitamin E, omega-6 fatty acids and omega-3 fatty acids are noted here as being at risk for children for the first time. All children had intakes of vitamin E below the EAR (Tables II and III). This is a significant concern, particularly for later development of chronic disease. While the state of the art of vitamin E dietary assessment is still evolving to reduce inaccuracies in measurement (38-43), there were few good sources of vitamin E in the children’s diets.

**Table V.** Summary of adequacy of nutrient intakes from diet only by Dene/Métis and Yukon children of 10-12 years of age.

| Probably inadequate | Possibly inadequate | Probably adequate |
|--------------------|---------------------|-------------------|
| > 50% of population below EAR/mean value below AI | 10% - 50% of population below EAR | < 10% of population below EAR/mean value above AI |
| - Vitamin A (girls and boys 2) | - Vitamin C (girls 2) | - Vitamin B6 (girls and boys 3) |
| - Vitamin D (girls and boys 3) | - Folate (girls and boys 2) | - Vitamin C (girls 1, boys 3) |
| - Vitamin E (girls and boys 3) | - Riboflavin (girls 1) | - Riboflavin (girls 2, boys 4) |
| - Calcium (girls and boys 2) | - Zinc (girls and boys 2) | - Zinc (girls 1) |
| - Magnesium (girls 3) | - Magnesium (girls 1, boys 3) | - Iron (girls and boys 3) |
| - Phosphorus (girls 3, boys 4) | - Phosphorus (boys 1) | - Copper (girls and boys 3) |
| - Dietary fibre (girls and boys 3) | - Protein (girls 2) | - Selenium (girls and boys 3) |
| - n-6 fatty acids (girls and boys 3) | - Protein (girls 3) | - manganese (girls and boys 3) |
| - n-3 fatty acids (girls and boys 3) | - Carbohydrate (girls and boys 3) | - Protein (girls 1, boys 2) |

1 in season 1 (Nov – Jan).
2 in season 2 (Aug – Oct).
3 in both seasons.

**Table VI.** Percentage of Dene/Métis and Yukon children outside of Acceptable Macronutrient Distribution Ranges (AMDRs) established for children of 4 – 18 years of age

| AMDRs (% of energy) | % out of range (below, above) | Girls (n = 128) | Boys (n = 94) |
|---------------------|-------------------------------|----------------|--------------|
|                     | Season 1 (n = 62) | Season 2 (n = 66) | Season 1 (n = 43) | Season 2 (n = 51) |
| Carbohydrate 45 – 65 | 33 (18, 15) | 19 (5, 14) | 26 (21.5) | 20 (6, 14) |
| Protein 10 – 30 | 11 (11, 0) | 8 (8, 0) | 14 (12, 2) | 2 (2, 0) |
| Fat 25 – 35 | 44 (21, 23) | 27 (15, 12) | 65 (14, 51) | 56 (28, 28) |
| n-6 fatty acids 5 – 10 | 82 (82, 0) | 85 (85, 0) | 79 (79, 0) | 78 (78, 0) |
| n-3 fatty acids 0.6 – 1.2 | 83 (81, 2) | 95 (95, 0) | 65 (63, 2) | 73 (73, 0) |

Season 1 is November – January and Season 2 August – October.
Table VI shows macronutrient intakes by Dene/Métis and Yukon children as a percent of the DRI Acceptable Macronutrient Distribution Ranges (AMDRs) for children of 4 to 18 years of age. AMDRs were set for individuals based on evidence to suggest a role in chronic disease and based on information ensuring sufficient intakes of essential nutrients (36). Consumption levels outside of these ranges indicate a possibility for increased risks of chronic diseases and of insufficient intakes of essential nutrients. Most children were found to be within the range for protein intake, but more than 20 percent of children were out of the ranges for carbohydrate, and more than 30 percent for total fat. A high proportion of children were below the acceptable ranges for omega-6 fatty acids and omega-3 fatty acids. These results suggest a better dietary balance is needed.

Nutrient and food group data from season 2 were also treated by BMI categories. There were no significant differences in macronutrient intake as percentages of the total energy intake by the children in the normal weight, risk of overweight, or overweight categories presented in Table 1; of the micronutrients, iron and vitamin B6 were significantly lower for overweight children, but median intakes for these children were still above the EAR indicating adequacy (not shown). No food group categories varied by BMI, indicating that the compositions of the diets of these children were reasonably similar. In these comparisons, consideration must be given to the small sample sizes of the groups compared.

The important messages of this research on dietary nutrients and anthropometry of Western Arctic Indigenous children are:

1) Many essential nutrients are likely to be adequate in these children’s diets: protein, carbohydrate, iron, copper, selenium, zinc, manganese, riboflavin (B2), pyridoxine (B6) and vitamin C. Adequacy of several of these is probably associated with an ample supply of quality protein foods, such as Arctic meats and fish (18).

2) Low intakes of calcium, vitamin D, fiber and the omega 3- and omega-6 fatty acids would be improved through a greater use of fish (and their bones), dairy products and whole grains.

3) Many children had inadequate intakes for vitamin A, vitamin E, phosphorus and magnesium. Again, more fish (and bone) would improve these nutrients in children’s diets.

4) Excessive overweight is reflected by the observation that 18-20 percent of the children in this study exceeded the 95th percentile of the CDC growth charts, and exceeded similarly derived overweight estimations of all-Canadian children (11-13.5 percent).

Increasing physical activity and reducing the intake of less nutrient-dense food should be combined with strategies to improve access to better quality MF and ample TF, in order to improve the overall health of Arctic children. These principles echo recommendations from other researchers (1-5, 44) working with Arctic and Sub-Arctic children, as well as adults, and with Indigenous children from other communities in North America (8-15, 30, 31). There is a great potential for proactive Arctic communities to improve children’s health by increasing physical activities and providing access to better quality food.
Acknowledgements
The authors thank the participating children and interviewers in Dene/Métis and Yukon communities. We also thank the Council of Yukon First Nations and the Dene Nation for acceptance of the study as a worthwhile endeavor. For funding support, we thank the Northern Contaminants Program of the Department of Indian and Northern Development and, within the Canadian Institutes of Health Research, we thank the Institute of Nutrition, Metabolism and Diabetes and the Institute of Aboriginal Peoples’ Health.

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