Developing a food frequency questionnaire in Alaska

ORIGINAL ARTICLE

DEVELOPING A VALIDATED ALASKA NATIVE FOOD FREQUENCY QUESTIONNAIRE FOR WESTERN ALASKA, 2002–2006

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ABSTRACT

Objectives. The purpose of this study was to develop a dietary instrument (food frequency questionnaire [FFQ]) that measured total dietary intake over 1 year among Alaska Native people in 2 regions. Ways of assessing diet are needed in order to accurately evaluate how the diets of Alaska Natives relate to their health.

Study design. Seasonal 24-hour (24-h) diet recalls were collected for developing an FFQ that described the average dietary foods and nutrients consumed. Alaska Native people living in 12 small communities in 2 regions of the state were eligible to participate.

Methods. Each participant was to provide 4 24-h diet recalls, 1 per season. Recalls were used to develop an FFQ using regression techniques. The FFQ was administered to 58 of the 333 original participants. Responses to the FFQ were compared to the averages of their 24-h recalls using the Spearman Correlation Coefficient.

Results. Energy-adjusted correlations ranged from 0.15 for protein to 0.49 for monounsaturated fatty acids. Fifteen of 26 nutrients examined were significantly correlated (total carbohydrates, sucrose, fructose, total fat, fatty acids [monounsaturated, polyunsaturated, omega 3, EPA, DHA], folate, vitamins A, C, D, potassium and selenium).

Conclusions. The FFQ can be used to evaluate intakes of Alaska Natives in western Alaska for the correlated nutrients.

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Keywords: Alaska Natives, food frequency questionnaire (FFQ), validation, diet
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INTRODUCTION

Dietary intakes of Alaska Natives differ from the general U.S. population (1). Alaska Natives have access to both the foods available in community stores and to their traditional subsistence foods (traditional, subsistence and Native foods are used interchangeably). The food harvests vary by region within Alaska. In some regions, salmon is a main food, while in others, land mammals (caribou or moose) are common foods, and in still other areas, Native people depend on sea mammals (whales, seals, walrus). In nearly all regions people eat wild greens and berries, which also vary by region (2–5). Because of the diversity of foods consumed by Alaska Native people, it is important to evaluate intake by region.

Methods currently used include a dietary record, 24-h recall, a food frequency questionnaire (FFQ) and a diet history questionnaire (DHQ) (6). The FFQ has become the primary method for measuring comparative dietary intake in epidemiological studies (7).

An FFQ is defined as a questionnaire in which the respondent is presented with a list of foods and indicates frequency and often quantity eaten over a defined period of time. Advantages are that they allow the measurement of the usual diet in one interview and are inexpensive when compared to multiple 24-h recalls. One disadvantage of the FFQ is that information may be lost by the limited number of foods included in the list. Although various FFQs have been developed elsewhere (6), differences in intake between rural Alaska Natives and other populations, especially the marked seasonal consumption of important subsistence foods (1), preclude their use among Alaska Native populations.

Some diet surveys have been conducted among Alaska Natives and published during the last 50 years. No comprehensive survey using standard methods and a random selection of participants similar to the National Health and Nutrition Examination Surveys (NHANES) has been done statewide in Alaska. NHANES itself has only collected information in Alaska twice and included a small total sample and few if any Alaska Native people. NHANES results are not reported by state or for American Indian/Alaska Native populations. Studies conducted in Alaska have used a variety of methods, including 24-h recalls, FFQs and DHQs.

Food lists for the FFQs were generated in different ways by different studies. In a study conducted in western Alaska, Murphy et al. selected a partial list of foods based on field testing and experience from past surveys to determine the 10 most common traditional foods and 15 store-bought foods most familiar to the regions (8). In the investigation on the St. Lawrence Island, Nobmann et al. selected 91 foods based on input from previous dietary recalls of Alaska Natives and on formative information solicited from community residents (9). In the GOCADAN study of 7 villages, the St. Lawrence Island FFQ was modified to include foods for the entire region and expanded to 97 foods (10). The Alaska Traditional Diet Project was conducted in 13 villages throughout the state, including 5 Native Health Corporation Regions. An FFQ was used that included food lists generated by the nutritionists and augmented by suggestions from a statewide oversight committee, village study coordinators, and interviewers (5). A core survey was used and supplemented with region-specific food lists. Smith et al. used the Block FFQ, which was validated among men and women in
the contiguous U.S., and added a supplemental page of Alaskan foods (11). To our knowledge, this modified FFQ has not been validated in Alaska.

The varied experience with FFQs in Alaska led us to conclude that there is a need for efficient, validated dietary assessment instruments that permit researchers to measure and compare the diet and nutrition of Alaska Native people. The goals of this study were to develop and validate an FFQ that can be used to accurately assess the influence of diet and nutrition on chronic diseases in selected regions of Alaska.

**MATERIAL AND METHODS**

**Identification of regions, villages and participants**

Alaska Native people include multiple ethnic and racial groups distributed widely across the state: the Inupiaq, Yupik and Cupik (Eskimo) in the northwest and western regions; the Athabascan and Tlingit, Haida, Tsimpsian in the interior and southeast, respectively; and the Aleut on the Alaska Peninsula, which is a part of the Aleutian Island chain. In addition to residing in different geographic and climatic regions, these groups differ in culture, lifestyle and language. Persons of all backgrounds live in the largest urban area, Anchorage.

Drawing on available study resources, communities in 2 different regions of Alaska were invited to participate based on their interest and their continued use of traditional foods; one region was in western Alaska and was connected to the Yukon-Kusukwim Health Corporation (YKHC), and the other was in northwest Alaska and worked in collaboration with the Maniilaq Association (Fig. 1).

In 2000, the Alaska Native population was 20,714 in the Yukon-Kusukwim Region (YKR) and 6,867 in the Maniilaq Region (MR). There are 48 Eskimo and Indian villages in the YKR, and 12 Inupiaq Eskimo communities in the MR.

**Figure 1.** Regions of western Alaska in which the Alaska Native Dietary and Subsistence Food Assessment Project was conducted, 2002–2006.
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The majority of residents of both regions maintain a lifestyle that blends subsistence living with a cash economy to varying degrees.

Specific villages were invited to participate based on their geographic location, size, and locally available foods. Six villages in each region that agreed to participate represented varieties of each of the criterion. Ten of 12 participating communities had populations of less than 1,000, while one in each region had populations of 3,200 and 6,000 – Maniilaq and YK, respectively. The 6 villages in the MR accounted for 50% of villages in that region while the 6 villages in YKR represented 13% of villages in that region. The study was approved by the Alaska Area Institutional Review Board, the Yukon-Kuskokwim Health Corporation, the Maniilaq Association and the village tribal councils.

All Alaska Native residents over 13 years of age in each village were invited to participate. The goal was to recruit 20 people per village, with not more than 1 participant per household and 5 people from each of the 4 age groups. Children less than 13 years of age were excluded to simplify data collection. The number of participants was determined by the representative age groups as defined by the Dietary Reference Intakes and by the practical consideration of how much time was available to each of the interviewers in the villages. A local assistant helped visiting interviewers identify residents who were likely to participate. Each participant signed an informed consent/assent form.

24-h recall collection phase
Interviewers selected by the community were trained by the authors (JSJ, EDN), and conducted interviews in either English or the appropriate Native language. Throughout 2002, initial 24-h recalls were collected face to face while subsequent recalls were done by telephone, which were completed in 2004. Because many foods are consumed only seasonally, a period was defined for each season, and each participant was interviewed at least once within each of the 4 seasons. A variety of standard cups, dishes, food models, measuring spoons, and rulers were available at the initial interview to record the accurate portion size. A set of measuring cups and spoons was left with each participant to help describe each portion size during telephone interviews.

Dietary data analysis
During 2005, dietary intake data were analyzed for nutrient content using Nutrition Data System for Research (NDS-R) software, version 5.0_35 (Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN). This software accepts foods, amounts consumed, preparation method and brand name information. The output gives nutrients consumed which were calculated using the software’s nutrient database. This process was adapted to calculate the FFQ nutrient intake for each individual. Although the nutrient values for many Alaska Native foods have been included in this database, for the foods not present, substitutions of similar foods were used. Other software used included SAS Version 9.1.3 (Cary, NC) and Microsoft Access 2003 (Bellingham, WA). The recall results per person were averaged to generate the individual’s mean daily nutrient intake.

To develop the FFQ, foods were selected from the 24-h recalls to reflect the usual intakes and the most common sources of selected nutrients. To maximize the percent of nutrients accounted for by the fewest foods,
a multiple regression technique was applied for each of the 16 nutrients of interest: kilocalories, protein, carbohydrate, fructose, sucrose, monounsaturated, polyunsaturated and saturated fats, omega-3 fatty acids, trans-fatty acids, calcium, iron, selenium, folate, vitamin A and vitamin C. Foods were selected for inclusion in the FFQ if they contributed to explaining the most between-person variance in the nutrient intake. For our FFQ, we expected the food list to account for a minimum of 85% of the variance based on 16 stepwise multiple regressions (R square >0.85) (7). Foods were included that discriminated or varied from person to person and that permitted ranking of individuals, which is often the primary objective in epidemiologic applications. For example, if all respondents ate the same amount of carrots, carrots would not discriminate, whereas if some people ate spinach and others didn’t, spinach would discriminate (7).

The FFQ was structured to record information on intake of game meats, birds, marine mammals and other Native foods; other types of meat; cereals, grain products and snack foods; vegetables; fruits; dairy products; and beverages; there was also an open-ended “other foods” category. The Native foods category included foods such as moose, caribou and bird soups, whale meat and muktuk, seal meat and seal oil, several types of fish that included salmon, tom cod, whitefish, herring and sheefish, fish eggs, berries, wild Alaska greens and agutuk (the recipe for “Eskimo ice cream” varies by region and by the one who makes it, but generally it is a mixture of fat, berries and sugar).

The general format of the FFQ was based on FFQs previously used in Alaska (3,4,10). Respondents reported frequency with which foods were eaten, the portion size, and season(s) consumed. Portion sizes could be reported as “about ½, 1, 2 or more” times the amount of the standard food model. These were 3-dimensional models of chicken, beef and fish (3 ounce sizes) (Nasco, Modesto, CA), 8-oz. measuring cup, 12-oz. coffee cup, 18-oz bowl, and 16-oz tumbler. The final FFQ contained 83 foods and it took approximately 30 minutes to complete. It contained 29 Native foods; 9 other meats; 13 cereals, grain products and snack foods; 9 vegetables; 3 fruits; 12 beverages; and 9 foods in an “others” category. The FFQ also included blank lines so that interviewees could write down any foods that were missed.

In 2006, to validate the FFQ, the questionnaire was administered by a registered dietitian (JSJ) to a convenience sample of participants in 7 of the 12 original villages. Each original participant in these communities who could be located was invited to complete the FFQ in a face-to-face interview in the village. Of those participants who agreed to the FFQ interview, 23 were from 3 villages in YKR, 35 were from four villages in the MR.

The ability of the FFQ instrument to measure nutrient intakes (validity) was evaluated by correlating nutrient intakes using Spearman Correlation Coefficients from the FFQ with those determined by the average 24-h recalls. Nutrient intakes were first adjusted for energy, which has been shown to improve correlations (7). Adjusting minimizes the effect that consuming extreme amounts of food, as measured by energy, may have on nutrient intakes. Additional evaluation of paired results for selected nutrients were compared by plotting the estimated true mean using the 2 collection methods against the difference in nutrient intake measured by the 2 methods (12).
RESULTS

A total of 333 participants enrolled and completed at least one 24-h recall; 177 from the YKR and 156 from MR. They ranged in age from 13 to 88, and included 218 females and 115 males. In all, 874 24-h recalls (on average 2.6 per person) were collected. A total of 1,818 different foods were reported. Of the 333 participants, 87 (26%) completed 4 24-h recalls, 168 (50%) completed 3 or more recalls and 252 (76%) completed 2 or more. Similar proportions of recalls were collected in each of the 4 seasons (30% fall, 27% winter, 20% spring and 23% summer). Of the 58 participants who completed the FFQ, 24 (41%) completed 4 24-h recalls, 44 (75%) participants completed 3 or more and 56 (97%) completed 2 or more.

Table I compares selected nutrient intakes from the 24-h recalls with the FFQ.

Daily mean intakes of energy were 2,719 kcal (11,376 kJ) using the FFQ and 2,222 kcal (9,309 kJ) using the 24-h recalls, a difference of 497 kilocalories (2,067 kJ) per day. Calculated kilocalorie intake using the FFQ ranged from 869 to 8,898 kcal/day; using the average of 24-h recalls intake ranged from 1,235 to 5,273 kcal/day. The median energy intakes were 2,490 kcal (10,418 kJ) using the FFQ and 2,157 kcal (9,025 kJ) using the 24-h recalls, a difference of 333 kcal (1,393 kJ). Only 2 participants using the FFQ, and 1 using 24-h recalls, had calculated energy intakes greater than 5,000 kcal (20,920 kJ) per day.

Table I. Daily nutrient intake from FFQs compared to 24-h recall results from 58 Alaska Native people averaged in 2 regions of Alaska, 2002–2006.

| nutrient          | FFQ     | SEM | Median | 24-h recall | SEM | Median |
|-------------------|---------|-----|--------|-------------|-----|--------|
| Energy, kcal      | 2719    | 193 | 2490   | 2225        | 94  | 2157   |
| Energy, kJ        | 11376   | 808 | 10418  | 9309        | 393 | 9025   |
| Protein, g        | 97      | 6.4 | 93     | 104         | 6   | 91     |
| Carbohydrate, g   | 352     | 30  | 325    | 247         | 12  | 229    |
| Sucrose, g        | 75      | 9.9 | 54     | 53          | 4.1 | 48     |
| Fructose, g       | 40      | 7.2 | 30     | 28          | 2.5 | 26     |
| Fat, g            | 103     | 7.6 | 91     | 92          | 5.4 | 86     |
| Saturated fats, g | 32      | 2.9 | 26     | 27          | 1.6 | 25     |
| Monounsaturated fats, g | 40 | 2.9 | 35 | 37 | 2.2 | 33 |
| ALA, g            | 1.3     | 0.1 | 1.2    | 1.3         | 0.1 | 1.3    |
| EPA, g            | 1.2     | 0.2 | 0.7    | 1.4         | 0.2 | 0.8    |
| DHA, g            | 1.7     | 0.2 | 1.0    | 1.9         | 0.3 | 1.0    |
| Trans fats, g     | 5.8     | 0.5 | 5.1    | 5.6         | 0.4 | 4.8    |
| Calcium, mg       | 662     | 62  | 574    | 468         | 33  | 419    |
| Iron, mg          | 25      | 1.7 | 24     | 22          | 1.5 | 20     |
| Selenium, mcg     | 165     | 12  | 146    | 161         | 11.2| 142    |
| Vitamin A, RAE    | 1556    | 108 | 1456   | 753         | 59  | 669    |
| Folate, mcg       | 590     | 44  | 563    | 362         | 18  | 303    |
| Vitamin C, mg     | 174     | 22  | 141    | 78          | 7.5 | 67     |
| Dietary fiber, g  | 18.6    | 1.4 | 15.9   | 11.6        | 0.7 | 10.4   |

*Polyunsaturated fatty acid (PUFA) 18:3.
** PUFA 20:5.
*** PUFA 22:6.
Table II lists the nutrient correlations of the average of each participant’s 24-h recalls and the FFQ. Correlations for the 16 nutrients considered in developing the FFQ ranged from 0.15 for protein to 0.49 for monounsaturated fatty acids. Ten additional nutrients of interest that were not used to develop the FFQ had correlation coefficients ranging from 0.02 for sodium to 0.41 for vitamin D. In all, 10 of the 26 nutrients examined had correlations above 0.4 and 15 were above 0.3. Plots of estimated mean intake of each nutrient against their difference revealed no bias associated with increased intakes.

**DISCUSSION**

There were several strengths to this study. We used standard methods to develop an FFQ for Alaska Natives targeting 2 regions of western Alaska. To develop the food list, we chose an open ended interviewer-administered 24-h recall over multiple daily food records for several reasons. The 24-h recall is considered to impose fewer burdens on the participant than other methods. People may decline to participate in a food record study because they do not wish to keep multiple detailed food records. In addition, where English is not the first language,
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reporting past 24-h intake to an interviewer may be easier than keeping written records. The open-ended 24-h recall allows identification of all possible foods for inclusion in the FFQ. That 1,818 foods were reported, both locally harvested and store-bought, illustrates the variety in the diet currently available in rural Alaskan communities. Since use of seasonal foods is particularly important in this population, the collection of up to 4 24-h recalls, each in a different season, provided the maximum opportunity to include seasonal foods. Use of the telephone for subsequent 24-h recalls has been used in another Alaskan diet survey (13). It increased the efficiency of this survey and, based on population-based research elsewhere, was unlikely to have influenced the respondents’ estimates of portion size (14). Further, by averaging 24-h recalls for each person, possible differences between the in-person survey and the telephone survey would be attenuated. This FFQ collected data on the quantity eaten, using measurement models to assist in reporting the quantity.

We intentionally sampled given numbers of participants in each age group to assure good representation. We have no reason to believe that people who participated in this project were different than those who did not participate with regard to eating patterns. Although, by selecting participants in this manner and limiting the selection to 5 people in each age group per village, we may have introduced some unknown bias such as 1 person with an unusual intake skewing results.

For our FFQ, we used personal interviews rather than self-administered surveys to provide an opportunity for participants to ask questions and to use 3-dimensional food models to estimate portion size. We also asked respondents to describe in which season of the year they consumed each food. This was helpful in assisting them to quantify use more precisely; however, it added a level of complexity to the survey.

Correlation coefficients have been the most common statistical method for assessing validity of FFQs (12). Our range of 0.15 to 0.49 compares with a range of 0.32 to 0.71 in a variety of studies outside of Alaska (7) and compares favourably with those found in the 1 previous Alaskan study reporting correlations (for carbohydrate 0.19 to 0.52 for saturated fatty acids) (10).

There may be several possible causes for somewhat lower correlation coefficients than ideally desired. One reason might be narrowing a long list of 1,818 food items to 83 foods. Another reason may be that data from 2 distinct geographic and cultural regions were aggregated in the analysis. Correlations between FFQ and 24-h recalls within each region may be higher; however, resources available for the study necessitated limiting FFQs to only a subset of communities and numbers were too small to analyse data by region. Furthermore, asking participants on a FFQ about broad categories of food (i.e., “Did you eat salmon?” versus a specific species such as “Did you eat king salmon?”) may have decreased the accuracy of intake reports.

One purpose of the FFQ was to measure average annual intake over the previous year. We feel it did that, although results appeared better for some specific nutrients than others based on correlation with the 24-h recalls.

There were several limitations to this study. Where correlations between the two methods were found, they were modest. Another limitation was the food models available for use. We share the concern of other investigators that the food models available may not have reflected the wide range of portion sizes that people
actually eat. Available models for meat were 85-g portions (a recommended serving size). However, our participants frequently reported portions of salmon that were ≥340 g. For future studies, creating and using larger food models could improve estimates of quantity.

Both FFQs and 24-h recalls were dependent on and limited by human recall. Analysis of biologic specimens concordant with collection of dietary intakes is recommended in studies of diet and nutrients and chronic diseases. However, this was beyond the objectives of this study.

Another limitation was the size of the study and especially the numbers of those who completed the FFQ. The size of Alaska, the disbursement of multiple small communities over a large area, the high costs of transportation and the availability of nutrition specialists only in the larger communities limited the size of our sample.

Another purpose of the study was to develop a tool to measure the average, annual dietary intake over the previous year and to measure the intake of select nutrients. The FFQ we developed appears to have done this, although the results of some components of the diet appear to be better measured than others.

In conclusion, the FFQ instrument can be used as a one-time survey to describe the average annual intakes of selected nutrients by Alaska Natives in the 2 regions of Alaska included in this study. It is best used in studies that are interested in the specific nutrients where we found correlations. It can be adapted and pilot tested for use in other regions of Alaska with minimal effort as it includes foods consumed in Alaska in contrast to FFQs developed and validated elsewhere. Although we did not analyse this, the FFQ could also be used to describe intakes of specific foods or food groups. Key food items were included in the FFQ for a variety of reasons pertinent to Alaskan research, including to determine general energy consumption, sources of energy and details of types of fat and specific carbohydrates; to assess relationships of nutrients with chronic diseases; to assess current intakes of nutrients previously shown to be low in some Alaskan studies and high in other studies; and to assess nutrients thought to be protective for food contaminants of concern to Alaskans such as selenium.

It may be used pending development and validation of future FFQs. Those interested in methodological refinements may wish to address more precise definitions of portion sizes, improved ways to measure seasonal intake, better ways to help respondents recall intakes of specific foods and better ways to increase correlations through other methods of selecting foods for the FFQ food list. For nutrients that can be measured in biologic samples, it would be important to validate the FFQ by using biomarkers.

Investigators who are interested in dietary intake are consistently challenged to obtain accurate measures of diet, something that varies within each individual by day, by food, and in Alaska, by season. At the same time, the task of assessing dietary intake should not be so onerous as to discourage or exclude it from important health research. Similarly, the process should not discourage or exclude people who may not wish to devote extensive time or recall to a diet survey. By improving the dietary assessment methodology of health investigations among Alaska Natives, we will strengthen our capacity to understand the fundamental contribution of diet to disease and wellness among this population, and any subsequent application of this knowledge will help to improve their overall health.
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The FFQ is available on request to Jennifer Johnson, Office of Wellness and Prevention, Alaska Native Tribal Health Consortium, 4000 Ambassador Dr, D-CHS, Anchorage, AK 99508.

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