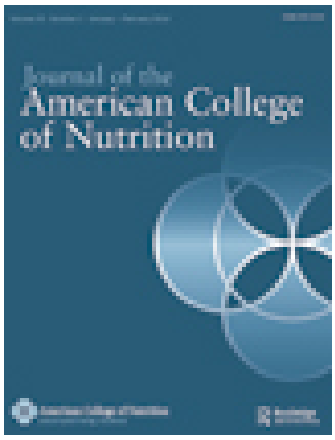

Journal of the American College of Nutrition
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/uacn20

Dietary Adequacy among Rural Yup'ik Women in Western Alaska

Sangita Sharma PhD[a], Erin Mead MHS[a], Desiree Simeon RD[b], Gary Ferguson PhD[b] & Fariba Kolahdooz PhD[a]

[a] Department of Medicine, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Alberta, CANADA

[b] Department of Wellness and Prevention, Community Health Services, Alaska Native Tribal Health Consortium, Anchorage, Alaska

Published online: 03 Feb 2015.

Original Research

Dietary Adequacy among Rural Yup'ik Women in Western Alaska

Sangita Sharma, PhD, Erin Mead, MHS, Desiree Simeon, RD, Gary Ferguson, PhD, Fariba Kolahdooz, PhD

Department of Medicine, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Alberta, CANADA (S.S., E.M., F.K.); Department of Wellness and Prevention, Community Health Services, Alaska Native Tribal Health Consortium, Anchorage, Alaska (D.S., G.F.)

Key words: 24-hour dietary recall, dietary adequacy, Yup'ik women, Alaska Native

Objectives: To assess (1) energy and nutrient intake; (2) dietary adequacy; (3) traditional and nontraditional foods consumed; and (4) main foods contributing to energy and selected nutrient intake among Yup'ik women in Western Alaska.

Methods: Up to 3 24-hour dietary recalls were collected to assess the dietary intake. Dietary adequacy was determined by comparing women's daily nutrient intakes to corresponding dietary reference intakes (DRIs).

Results: Mean daily energy intake for the women was 2172 kcal, exceeding the DRI for energy. The majority of women (90–100%) fell below the recommendations for dietary fiber, calcium, and vitamins D and E. More than 50% of women fell below the recommendations for vitamin A, and more than one third were below the DRI for zinc and vitamins C and B_6. Juices/pop (including Tang, Kool-Aid, soda/pop, fruit juice, and energy drink), coffee, and traditional fish were the most frequently reported food items. Sweetened beverages and pop were the main contributors to energy, carbohydrate, and sugar intake. Traditional foods provided 34% of protein, 27% of iron, 23% of vitamin A, and 21% of zinc.

Conclusions: Among Yup'ik women, juices/pop were the most frequently consumed foods contributing to the high energy intake. However, traditional food still contributes substantially to certain nutrients. These data contribute to an understanding of dietary adequacy in this population and will aid in the development of a nutritional intervention program.

INTRODUCTION

Land and marine mammals, fish, and plants and berries have historically been resources for subsistence of Alaska Native (AN) populations [1,2]. These foods, which have long been at the heart of these populations' economic, cultural, and spiritual livelihoods, have also served as rich sources of nutrients necessary for survival amidst harsh environmental conditions [3]. However, several factors threaten food security in this region, including climate change and environmental contamination [4]. These factors, along with integration of Western culture into the traditional lifestyle, are thought to have influenced the rapid dietary transition among AN populations and other inhabitants of the Arctic regions [5,6]. Subsistence or "traditional" foods are still collected and consumed; however, less nutritious foods purchased in grocery stores are gaining popularity [7–10]. A 1992 study documented that traditional foods provided Yup'ik adults in Alaska with 25% of their energy [11]. In 2000–2003, AN adults in the Norton Sound region of Alaska obtained 15% of their energy from traditional foods [8].

The dietary transition has resulted in a decrease in diet quality among AN populations [12,13]. Traditional foods tend to be nutrient dense, providing rich sources of protein, iron, vitamin A, vitamin B_{12}, and omega-3 fatty acids [8,9,12,14–20]. A recent study of adults in western Alaska found that these foods provided 46% of the protein, 3% of the carbohydrates, 85% of eicosapentaenoic acid (EPA), and 81% of vitamin D [9]. In contrast, Western or store-bought foods are associated with higher fat, saturated fat, and sugar intakes [9,12,21].

A growing body of evidence supports the notion that the changing diet may be linked to the increasing risk of chronic

Address correspondence to: Sangita Sharma, Endowed Chair in Aboriginal Health, Professor of Aboriginal and Global Health Research, Department of Medicine, University of Alberta, Unit 5-10, University Terrace, 8303 112th Street, Edmonton, AB, CANADA T6G 2T4. E-mail: gita.sharma@ualberta.ca
Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/uacn.

Journal of the American College of Nutrition, Vol. 0, No. 0, 1–8 (2014) © American College of Nutrition/
Published by Taylor & Francis Group, LLC

disease observed in AN populations [22–24]. Cancer is now the leading cause of death, and cancer mortality rates among AN populations are significantly higher than the U.S. average [25]. Furthermore, diabetes is increasing at a faster rate among AN groups than in any other population in North America [26]. Cardiovascular disease mortality rates, which were historically low [27], are now 30 and 40% higher in the age groups 25–44 years and 45–54 years, respectively, than among U.S. Caucasians [28]. Consumption of nontraditional foods, as well as infrequent salmon and seal oil intake, has been shown to be associated with glucose intolerance and overweight among Alaskan Yup'iks [8,21]. A study among Yup'iks in Alaska showed that traditional foods were negatively correlated with blood lipid levels; this is beneficial because raised plasma lipid concentrations are associated with increased cardiovascular disease risk [19].

Dietary modification is an essential part of chronic disease prevention in AN populations. However, more research on current diet and dietary adequacy among AN groups is needed before appropriately targeted interventions can be implemented. Because of the large diversity of foods consumed by these groups, it is important to evaluate intake by region. Thus, the objectives of the present study are to characterize the current diet of Yup'ik women in rural western Alaska using 24-hour dietary recalls to assess (*a*) energy and nutrient intake, (*b*) dietary adequacy, (*c*) most common traditional and nontraditional foods consumed, and (*d*) the main foods contributing to energy and nutrients of interest.

METHODS

Setting

This study took place in 6 remote communities in southwestern Alaska, primarily located in Bethel (81% AN) and Wade Hampton (91% AN) census areas. In 2008, the population was estimated to be 24,953 in this region [29]. Populations of the participating 6 communities ranged from approximately 270 (80 households) to 760 (150 households) [30]. Communities were geographically remote; they were not on a road system and were accessible only by small plane year-round, boat in the summer, and snow machine in the winter. Each community had 2 small stores that were stocked with foods and other goods supplied by small plane or barge. Communities are governed by tribal councils and both Yup'ik and English are spoken. In 2007, 21 and 27% of people lived below the poverty level in the Bethel and Wade Hampton census regions, respectively [29].

Sampling

AN women who were Yup'ik and ≥18 years of age were randomly recruited. Pregnant and lactating women were not included because of their different nutritional requirements. Participants were randomly selected using community maps to ensure that all areas of the community were represented. To ensure maximum diversity in reported diet, one person who was the main food shopper and/or preparer was recruited per household [9].

Data Collection

Data collection occurred for one week in each of the 6 communities. Up to 3 24-hour recalls were collected from each respondent and were administered by one dietitian and one research assistant who had undergone training in instrument administration and data collection procedures. Participants were interviewed in community locations provided by the local tribal council or the school in each community. Prior to the interview, each participant was informed about the purpose of the study and the data collection instrument used, and signed consent was obtained.

The interview was conducted in a multiple-pass format. Questions were open-ended, allowing specificity of food type, amount, food processing method, food preparation, and other details related to foods and amounts consumed. To assist in recall of accurate portion size information, the interviewers used a standard set of cups, bowls, and spoons familiar to the communities. Three-dimensional food models were developed to reflect serving sizes familiar to respondents in this area and to allow for reporting of a wide variety of different portion sizes. To facilitate accurate portion size estimation, packages of foods available in local stores, such as chips and canned vegetables, were also used as models. Participants were encouraged to report the amount of food they consumed in relation to the food models, household utensils (e.g., teaspoon or serving spoon), or standard units (e.g., a slice of bread or an egg). At the end of each recall, the interviewer asked several questions to help capture easily forgotten food items, such as snacks and sweets, and checked the recall for completeness. Twenty-four-hour recalls were collected representing all days of the week (both weekends and weekdays), and data were collected on nonconsecutive days. Participants received a small incentive ($5) for each recall completed.

Portion Weights

Food amounts reported on the recalls were weighed by trained personnel using an electronic Aquatronic Baker's Dream Scale (Salter Houseware Ltd., Tonbridge, UK). The average portion weight for a given food model was calculated using up to 10 consecutive weight measurements. Standard recipes for mixed dishes were determined, prepared, and weighed as above.

Data Analysis

All food items, recipes, and beverages reported on the 24-hour recalls were entered into NutriBase Clinical Nutrition Manager Ver. 7·17 (CyberSoft, Inc., Phoenix, AZ). This allowed

determination of mean daily energy and nutrient intakes using U.S. food composition tables for available foods [31].

For energy and selected nutrients, mean, median, and standard deviation (SD) of intake were determined. The percentage of participants below the dietary reference intakes (DRIs) [32] was determined for specific nutrients, based on DRI age groups (19–30, 31–50, 51–70, and >70 years). Results were combined for the 2 younger age groups (19–30 and 31–50 years) and the 2 older age groups (51–70 and >70 years) due to the small sample size. The percentage contribution of foods to energy and selected nutrient intake was determined. Similar food items (i.e., different types of traditional meats) were grouped to determine percentage contribution to diet. A traditional food was defined as one acquired through subsistence practices. Within-person variation needs to be considered when analyzing 24-hour dietary recalls; consequently, participants with only one recall are often excluded from this type of analysis. However, in our analysis exclusion of women with only one 24-hour dietary recall did not change the results substantially and, therefore, we were confident to include them in our analyses. No participant needed to be excluded due to extreme energy intake (<500 or >7000 kcal). Dietary adequacy and descriptive statistics were calculated using SAS statistical software, Ver. 9·3 (SAS Institute, Cary, NC).

RESULTS

Of the 82 women recruited, 48 completed one 24-hour dietary recalls, 20 completed 2 24-hour dietary recalls, and 14 completed all 3 (overall 130 days of recalls). The mean age of respondents was 43·1 years (SD = 14·5; range = 19–74). The response rate was 59%.

Energy and Nutrient Intakes and Dietary Adequacy

Mean intakes of energy and selected nutrients are presented in Table 1. Overall, mean (SD) intake values exceed the recommendations for energy, riboflavin, niacin, vitamin B_{12}, and vitamin C. In contrast, mean intakes of fiber, vitamin A, vitamin D, vitamin E, and calcium were below recommended levels. Mean (SD) macronutrient intake was 79.1 (36.7) g for fat, 86.2 (37.3) g for protein, and 282.9 (133.0) g for carbohydrate.

Table 2 summarizes the proportion of participants who did not meet the dietary recommendations. The majority of women (90–100%) fell below the recommended values for dietary fiber, calcium, vitamin D, and vitamin E. More than 50% of women fell below the DRIs for vitamin A and more than one third were below the DRI for vitamin B_6, vitamin C, and zinc.

Table 1. Mean, SD, and Median Daily Energy and Nutrient Intake among Alaskan Women ($n = 82$)

	Mean	SD	Median	DRI
Energy (kcal)	2,171.7	808.9	1,922.8	1,800[a]
% Energy from fat	32.7	10.5	31.0	20–35[b]
% Energy from carbohydrates	51.0	11.6	51.5	45–65[b]
% Energy from protein	16.3	5.3	15.6	10–35[b]
Fat (g)	79.1	36.7	69.1	—
Saturated fat (g)	22.6	11.6	21.0	<10% of energy[c]
Protein (g)	86.2	37.3	79.3	—
Carbohydrate (g)	282.9	133.0	255.5	—
Sugars (g)	129.5	77.2	118.0	<25% of energy[a]
Dietary fiber (g)	11.1	8.7	8.4	25[d]
Monounsaturated fat (g)	23.4	13.7	20.3	—
Polyunsaturated fat (g)	10.8	6.6	8.5	—
Omega-3 fatty acid (g)	0.9	0.9	0.7	—
Omega-6 fatty acid (g)	6.1	4.6	5.0	—
Cholesterol (mg)	287.9	209.8	209.6	As low as possible
Vitamin A (μg-RAE)	584.8	541.5	403.1	700[e]
Thiamin (mg)	1.5	0.7	1.3	1.1[e]
Riboflavin (mg)	2.1	0.8	2.0	1.1[e]
Niacin (mg)	24.2	10.0	21.8	14[e]
Vitamin B_6 (mg)	1.6	0.9	1.4	1.3[e]
Vitamin B_{12} (μg)	5.6	5.3	4.5	2.4[e]
Vitamin C (mg)	127.0	128.7	93.5	75[e]
Vitamin D (IU)[f]	41.3	66.4	17.6	200[d]
Vitamin E (mg)[g]	3.0	2.1	2.2	15[e]
Total folate (μg-DFE)	442.8	229.3	406.8	400[e]
Calcium (mg)	512.1	290.9	469.2	1,000[e]
Iron (mg)	18.2	12.9	14.9	18[e]
Zinc (mg)	9.3	5.9	8.2	8[e]

DRI = dietary reference intakes, RAE = retinol activity equivalents, DFE = dietary folate equivalent.

[a]Estimated amount of kilocalories needed to maintain energy balance for women aged between 31 and 50 years at the level of very low physical activity–sedentary level.

[b]Acceptable macronutrient distribution ranges.

[c]Recommendation on saturated fat intake by Joint World Health Organization/Food and Agriculture Organization Expert Consultation [33].

[d]Adequate intake.

[e]Recommended dietary allowance.

[f]As cholecalciferol. In the absence of adequate exposure to sunlight.

[g]As alpha-tocopherol.

Primary Food Sources and Foods Contribution to Energy and Nutrients

Juices and pop were reported by 69% of the respondents and were reported 215 times in all recalls combined, followed by coffee (66%, 152 times) and traditional fish (65%, 87 times; Table 3). Traditional fish, which primarily included salmon, was among the 5 most commonly reported foods. Vegetables ranked seventh (45%, 122 times), and fruits were not among the top 10 most frequently reported food items.

Table 4 describes the main food sources of selected nutrients. Sweetened juices and drinks as well as soda were major contributors of energy (8.2%), carbohydrates (16.1%), and sugar (32.7%). The top food source of fiber was vegetables (12.5%), and 14.0% of iron intake was derived from cereals.

Table 2. Frequency (Percentages) of Alaskan Women ($n = 82$) below the Dietary Reference Intakes

Nutrient	*N* (%)
Dietary fiber (g)[a]	74 (90.2)
Calcium (mg)[a]	76 (92.7)
Total folate (μg-DFE)[b]	24 (29.3)
Vitamin A (μg-RAE)[b]	47 (57.3)
Vitamin B_6[b] (mg)	35 (42.7)
Vitamin C[b] (mg)	31 (37.8)
Vitamin D[a,c] (IU)	81 (98.8)
Vitamin E[b,d] (mg)	82 (100.0)
Iron (mg)[b]	5 (6.1)
Zinc (mg)[b]	30 (36.6)

DFE = dietary folate equivalent; RAE = retinol activity equivalents.

[a]Adequate intake used for comparison.

[b]Estimated average requirement used for comparison.

[c]As cholecalciferol in the absence of adequate exposure to sunlight.

[d]As alpha-tocopherol.

Traditional foods, specifically seal or whale oil, were the main contributors (9.8%) to total fat, and traditional fish (14.8%) was the main source of protein. For calcium, milk (17.9%) and sweetened juices and drinks (16.3%) were main contributors. In total, traditional foods accounted for 34% of protein, 27% of iron, 23% of vitamin A, 21% of zinc consumption, 24% of fat, and 17% of total energy (Fig. 1).

DISCUSSION

This study presents essential data on current consumption of traditional and nontraditional foods as well as nutrients among Yup'ik women in rural western Alaska. Participants relied on mostly imported store-bought foods such as pop, soda, and energy drinks rather than traditional foods, supporting evidence that a nutrition transition is underway among AN populations [34,35]. Traditional fish, such as salmon, was among the 5 most frequently reported items. Nevertheless, traditional foods were the main contributors to selected nutrient intakes. Traditional foods contributed significantly to protein, iron, and vitamin A intakes, confirming previous studies that traditional foods continue to play an important role in the diet quality of this population [2,8–10].

Table 3. Most Commonly Reported Foods among Yup'ik Women ($n = 82$) in 6 Communities in Western Alaska

Food Item	% of Respondents	No. of Times Reported
Juice and pop[a]	69	215
Coffee	66	152
Traditional fish	65	87
Water	63	130
Rice or pasta	59	125
Sugar	53	138
Vegetables	48	122
Lipids/fats	45	114
Crackers	45	70
Bread	42	96

[a]Including Tang, Kool-Aid, soda/pop, fruit juice, energy drinks.

Juices and pop (including Tang, Kool-Aid, soda/pop, fruit juice, energy drinks) were the main contributors to energy, carbohydrates, and sugar. The mean carbohydrate intake of AN women in this study was significantly higher than that observed prior to the availability of store-bought foods; historically, carbohydrate intake was low, derived mainly from berries, roots, greens, and stomach contents of herbivorous animals [36]. The increasing proportion of carbohydrates in the diet over the past few decades has been associated with concurrent increases in diabetes and obesity [24].

In concordance with previous studies in Alaska [8,9,13], the present study reports a high intake of sweetened beverages, including pop, Kool-Aid, and Tang. Increased soft drink consumption has been linked to increased energy intake and decreased consumption of milk, calcium, and other nutrients, as well as increased rates of diabetes, metabolic syndrome [37], and high blood pressure [38]. In addition, the mean reported intake of sugar surpassed the recommendations of the American Heart Association of 100 kcal per day of added sugars (added during processing and at the table), as well as the average U.S. intake of 22.2 teaspoons (355 kcal) per day [39]. Excess sugar consumption has been linked to metabolic abnormalities, including elevated blood lipids, decreased insulin sensitivity [40], and diets that are deficient in essential nutrients [41]. Interestingly, in this study cereals were the main contributors to iron intake, a benefit of the commercial enrichment of flour and grain products with iron in the United States [42]. Low intake of iron is rarely noted as a problem in Alaska, and previous studies have reported that iron intake often meets or exceeds recommendations [8,9,13].

Intakes of several important nutrients, such as calcium and vitamin D, were below recommendations. Low calcium intake has been previously reported [11]. Low levels of calcium and vitamin D have been shown to affect bone health in people of all ages, causing rickets in infants, inadequate bone mass acquisition during skeletal development in adolescents, and accelerated bone loss in adulthood, leading to the development of osteoporosis [43,44]. Osteoporosis is an important public health concern for AN women, especially as their life expectancy increases. Low bone density affects 45% of AN women as evidenced by hip, ankle, and foot fractures and osteoporosis diagnosis [45]. Additionally, coffee was among the most frequently reported food items, which may have a further negative impact on bone health [46].

As shown in previous studies, AN women in this study had a low dietary fiber intake possibly due to a low consumption of fruit and vegetables [8,13,47]. This is a potential area of concern for this population because fruits and vegetables are a good source of fiber, vitamins, and antioxidants, which might

Table 4. The 5 Major Food Sources of Energy and Selected Nutrients in Alaskan Adults (% Contribution)

Food	Energy	Food	Total Fat	Food	Protein	Food	Carbohydrate
Sweetened juices and drinks	8.2	Traditional fats	9.8	Traditional fish	14.8	Sweetened juices and drinks	16.1
Sweets desserts	7.2	Butter/margarine/oil/shortening	9.4	Beef	12.6	Soda	10.4
Bread	6.2	Beef	8.4	Poultry	9.1	Sweets/desserts	8.4
Crackers	5.6	Sausage/lunchmeat	7.8	Caribou	8.8	Bread	8.3
Beef	5.4	Sweet/desserts	7.6	Bread	4.6	Crackers	7.3
Total	32.6	Total	43.1	Total	49.9	Total	50.5
Food	Sugar	Food	Fiber	Food	Calcium	Food	Iron
Sweetened juices and drinks	32.7	Vegetables	12.5	Milk	17.9	Cereals	14.0
Soda	21.8	Bread	10.2	Sweetened juices and drinks	16.3	Caribou	10.6
Sugar/syrup/honey	10.9	Nontraditional soup	8.5	Bread	11.7	Seal	9.5
Fruit	4.7	Cereal	8.0	Sweets/desserts	5.7	Bread	7.9
Agutuk[a]	2.7	Sweets/desserts	5.8	Cheese	5.7	Beef	7.4
Total	83.4	Total	49.2	Total	57.4	Total	49.4

[a]Traditional ice cream made of berries, seal oil, shortening or animal fat, and sugar.

beneficially modulate development of several cancers, heart disease, diabetes, and obesity [48].

The present findings underscore the need for dietary interventions that provide culturally appropriate nutrition education as an effective means to promote the adoption and maintenance of healthy dietary practices [49]. Ebbesson et al. demonstrated that a dietary intervention based on both traditional and healthy commercial foods can decrease plasma concentrations of total cholesterol and low-density lipoprotein cholesterol, reduce diastolic blood pressure, and improve glucose tolerance in AN populations in northwest Alaska [50]. Given the study sample's high consumption of energy, carbohydrate, and sugar, this population may benefit from such an intervention. Furthermore, the women in this study had low dietary calcium and vitamin D intakes, frequent coffee consumption, and low fiber intake, which could also be the focus of an intervention. A diet and lifestyle intervention called Healthy Foods North was developed for implementation in Inuit and Inuvialuit communities of Arctic Canada [51] and proved effective in reducing total energy and carbohydrate intake and increasing intake of some important micronutrients, such as vitamins A and D [52]. Because the dietary adequacy and environmental factors observed in this study are similar to those observed among Canadian Aboriginal populations [53,54], such an intervention strategy could also be an effective means of diet and health improvement among Alaska Native people.

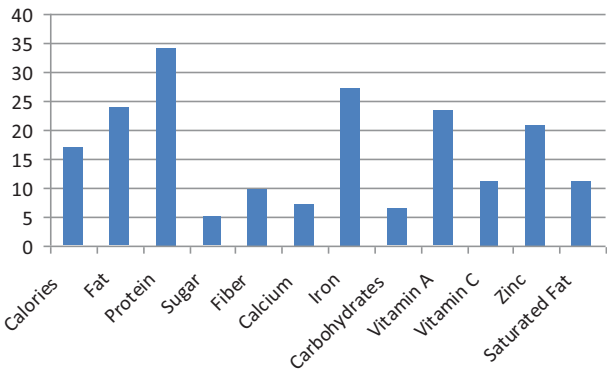

Fig. 1. Percentage of the contribution of traditional foods to energy and selected nutrients in Alaska Native ($n = 82$) women in 6 communities in western Alaska.

There are some limitations in this study. The 24-hour recalls were collected within a short period of time in spring and winter and therefore did not completely account for seasonal variability, specifically during the summer months. Furthermore, only women were surveyed, limiting the generalizability of the results to the communities' total populations or other AN population groups. However, the aim of this study was to collect data on household members who make the decisions regarding food purchases and preparation, and these are primarily women.

This study has several strengths; it adds to the body of knowledge on current diet among AN women in western Alaska. Data were collected by a dietitian familiar with the population and assisted by community residents familiar with the local diet and language. During the 24-hour recalls locally appropriate food models were used and local recipes were included in the food analysis.

CONCLUSION

These findings serve as a basis for the development of dietary interventions and recommendations intended to prevent chronic disease among AN women. For women 19–74 years of age in these 6 communities, dietary recommendations might include the following: (1) support the continued use of traditional foods due to their high content of essential nutrients; the physical benefits associated with hunting, gathering, and

preparing traditional foods; and their contribution to maintaining the cultures of AN people; (2) continued maintenance of energy balance through limiting the intake of calories, especially sweetened beverages that are high in energy and low in nutrient value; (3) increase the consumption of fiber-rich foods, including vegetables, fruits, and whole grains; and (4) ensure optimal consumption of minerals and vitamins, especially calcium, by encouraging the consumption of reduced-fat milks and calcium-rich beverages such as calcium-fortified orange juice. Other traditional sources of calcium such as soups made from animal bones, whole fish/bones, and local greens/plants could also be encouraged. An intervention targeting the present population of women would likely benefit men and children in these communities as well, because women are the primary decision makers with regard to food purchase and preparation.

ACKNOWLEDGMENTS

We acknowledge the assistance of Jennifer Johnson, as well as the Yukon-Kuskokwim Health Corporation and the Norton Sound Health Corporation, and all of the people who so generously gave of their time and knowledge in each community.

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Alaska Area Institutional Review Board, the Yukon Kuskokwim Health Corporation, the Norton Sound Health Corporation, and the Office of Human Research Ethics at the University of North Carolina at Chapel Hill. The project was presented to the tribal councils and a written resolution of willingness to participate was granted by each community.

FUNDING

This project was supported by the National Research Initiative Grant 2007-55215-17923 from the USDA Cooperative State Research, Education and Extension Service. The USDA Cooperative State Research, Education and Extension Service had no role in the design, analysis, or writing of this article.

AUTHOR CONTRIBUTIONS

The author's responsibilities were as follows: S.D., F.G., and F.K. drafted the article; S.S. designed the study and provided essential data and finalized the article; and all authors read and approved the final artice.

REFERENCES

1. Schraer C: Diabetes among the Alaska Natives—the emergence of chronic disease with changing lifestyles. In Joe JR, Young RS (eds): "Diabetes as a Disease of Civilization: The Impact of Cultural Change on Indigenous Peoples." Berlin: Mouton deGruyter, pp 169–195, 1993.
2. Johnson JS, Nobmann ED, Asay E, Lanier AP: Developing a validated Alaska Native food frequency questionnaire for western Alaska, 2002–2006. Int J Circumpolar Health 68:99–108, 2009.
3. Magdanz JS, Walker RJ, Paciorek RR: The subsistence harvests of wild foods by residents of Shungnak, Alaska. 2002. Accessed at: http://www.subsistence.adfg.state.ak.us/TechPap/tp279.pdf
4. Duerden F: Translating climate change impacts at the community level. Arctic 57:204–212, 2004.
5. Condon RG, Collings P, Wenzel G: The best part of life: subsistence hunting, ethnicity, and economic adaptation among young adult Inuit males. Arctic 48:31–46, 1995.
6. Kuhnlein HV, Receveur O, Soueida R, Egeland GM: Arctic indigenous peoples experience the nutrition transition with changing dietary patterns and obesity. J Nutr 134:1447–1453, 2004.
7. Heller CA, Scott EM: "The Alaska Dietary Survey, 1956–1961." Anchorage, AK: Arctic Health, 1961.
8. Nobmann ED, Ponce R, Mattil C, Devereux R, Dyke B, Ebbesson SOE, Laston S, MacCluer J, Robbins D, Romenesko T, Ruotolo G, Wenger CR, Howard BV: Dietary intakes vary with age among Eskimo adults of Northwest Alaska in the GOCADAN study. J Nutr 135:856–862, 2005.
9. Johnson JS, Nobmann ED, Asay E, Lanier AP: Dietary intake of Alaska Native people in two regions and implications for health: the Alaska Native Dietary and Subsistence Food Assessment Project. Int J Circumpolar Health 68:109–122, 2009.
10. Ballew C, Tzilkowski AR, Hamrick K, Nobmann ED: The contribution of subsistence foods to the total diet of Alaska Natives in 13 rural communities. Ecol Food Nutr 45:1–26, 2006.
11. Nobmann ED, Ebbesson SO, White RG, Schraer CD, Lanier AP, Bulkow LR: Dietary intakes among Siberian Yupiks of Alaska and implications for cardiovascular disease. Int J Circumpolar Health 57:4–17, 1998.
12. Bersamin A, Zidenberg-Cherr S, Stern JS, Luick BR: Nutrient intakes are associated with adherence to a traditional diet among Yup'ik Eskimos living in remote Alaska Native communities: the CANHR Study. Int J Circumpolar Health 66:62–70, 2007.
13. Bersamin A, Luick BR, Ruppert E, Stern JS, Zidenberg-Cherr S: Diet quality among Yup'ik Eskimos living in rural communities is low: the Center for Alaska Native Health Research Pilot Study. J Am Diet Assoc 106:1055–1063, 2006.
14. Kuhnlein HV: Nutrition of the Inuit: a brief overview. Arctic Med Res 50:728–730, 1991.
15. Receveur O, Kuhnlein HV: Benefits of traditional food in Dene/Métis communities. Int J Circumpolar Health 57:219–221, 1998.
16. Risica PM, Nobmann ED, Caulfield LE, Schraer C, Ebbesson SO: Springtime macronutrient intake of Alaska Natives of the Bering Straits Region: the Alaska Siberia Project. Int J Circumpolar Health 64:222–233, 2005.

17. Kuhnlein HV, Receveur O: Local cultural animal food contributes high levels of nutrients for Arctic Canadian Indigenous adults and children. J Nutr 137:1110–1114, 2007.
18. Sharma S, Cao X, Gittelsohn J, Ho LS, Ford E, Rosecrans A, Harris S, Hanley AJ, Zinman B: Dietary intake and development of a quantitative food-frequency questionnaire for a lifestyle intervention to reduce the risk of chronic diseases in Canadian First Nations in northwestern Ontario. Public Health Nutr 1:831–840, 2008.
19. Nobmann ED, Ebbesson SO, White RG, Bulkow LR, Schraer CD: Associations between dietary factors and plasma lipids related to cardiovascular disease among Siberian Yupiks of Alaska. Int J Circumpolar Health 58:254–271, 1999.
20. Receveur O, Boulay M, Kuhnlein HV: Decreasing traditional food use affects diet quality for adult Dene/Métis in 16 communities of the Canadian Northwest Territories. J Nutr 127:2179–2186, 1997.
21. Murphy NJ, Schraer CD, Thiele MC, Boyko EJ, Bulkow LR, Doty BJ, Lanier AP: Dietary change and obesity associated with glucose intolerance in Alaska Natives. J Am Diet Assoc 95:676–682, 1995.
22. Slattery ML, Murtaugh MA, Schumacher MC, Johnson J, Edwards S, Edwards R, Benson J, Tom-Orme L, Lanier AP: Development, implementation, and evaluation of a computerized self-administered diet history questionnaire for use in studies of American Indian and Alaskan native people. J Am Diet Assoc 108:101–109, 2008.
23. Eilat-Adar S, Mete M, Nobmann ED, Xu J, Fabsitz RR, Ebbesson SOE, Howard BV: Dietary patterns are linked to cardiovascular risk factors but not to inflammatory markers in Alaska Eskimos. J Nutr 39:2322–2328, 2009.
24. Friborg JT, Melbye M: Cancer patterns in Inuit populations. Lancet Oncol 9:892–900, 2008.
25. Lanier AP, Day GE, Kelly J, Provost E: Disparities in cancer mortality among Alaska Native people, 1994–2003. Alaska Med 49:120–125, 2008.
26. Naylor JL, Schraer CD, Mayer AM, Lanier AP, Treat CA, Murphy NJ: Diabetes among Alaska Natives: a review. Int J Circumpolar Health 62:363–387, 2003.
27. Schumacher C, Davidson M, Ehrsam G: Cardiovascular disease among Alaska Natives: a review of the literature. Int J Circumpolar Health 62:343–359, 2003.
28. Ebbesson SO, Adler AI, Risica PM, Ebbesson LO, Yeh JL, Go OT, Doolittle W, Ehlert C, Swenson M, Robbins DC: Cardiovascular disease and risk factors in three Alaskan Eskimo populations: the Alaska–Siberia project. Int J Circumpolar Health 64:365–386, 2005.
29. US Census Bureau: State and County Quick Facts. 2010. Accessed at: http://quickfacts.census.gov/qfd/states/00000.html
30. State of Alaska: Community Database Online. 2009. Accessed at: http://www.dced.state.ak.us/dca/commdb/CF_COMDB.htm
31. US Department of Agriculture, Agricultural Research Service: USDA National Nutrient Database for Standard Reference, Release 21. 2009. Accessed at: http://www.ars.usda.gov/ba/bhnrc/ndl
32. Institute of Medicine of the National Academies: "Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids." Washington, DC: The National Academies Press, 2005.
33. Diet, Nutrition and the Prevention of Chronic Diseases. Report of a Joint WHO/FAO Expert Consultation. WHO Technical Report Series No. 916. Geneva: World Health Organization, 2003.
34. Curtis T, Kvernmo S, Bjerregaard P: Changing living conditions, life style and health. Int J Circumpolar Health 64:442–450, 2005.
35. Bersamin A, Luick BR, King IB, Stern JS, Zidenberg-Cherr S: Westernizing diets influence fat intake, red blood cell fatty acid composition, and health in remote Alaskan Native communities in the center for Alaska Native health study. J Am Diet Assoc 108:266–273, 2008.
36. Draper HH: The aboriginal Eskimo diet in a modern perspective. Am Anthropol 79:309–316, 1977.
37. Vartanian LR, Schwartz MB, Brownell KD: Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. Am J Public Health 97:667–675, 2007.
38. Dhingra R, Sullivan L, Jacques PF, Wang TJ, Fox CS, Meiga JB, D'Agostino RB, Gaziano JM, Vasan RS: Soft drink consumption and risk of developing cardiometabolic risk factors and the metabolic syndrome in middle-aged adults in the community. Circulation 116:480–488, 2007.
39. Johnson RK, Appel LJ, Brands M, Howard BV, Lefevre M, Lustig RH, Sacks F, Steffen LM, Wylie-Rosett J: Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. Circulation 120:1011–1020, 2009.
40. Stanhope KL, Schwarz JM, Keim NL, Griffen SC, Bremer AA, Graham JL, Hatcher B, Cox CL, Dyachenko A, Zhang W, McGahan JP, Seibert A, Krauss RM, Chiu S, Schaefer EJ, Ai M, Otokozawa S, Nakajima K, Nakano T, Beysen C, Hellerstein MK, Berglund L, Havel PJ: Consuming fructose-sweetened, not glucose-sweetened, beverages increases visceral adiposity and lipids and decreases insulin sensitivity in overweight/obese humans. J Clin Invest 119:1322–1334, 2009.
41. Gibson SA: Dietary sugars intake and micronutrient adequacy: a systematic review of the evidence. Nutr Res Rev 20:121–131, 2007.
42. World Health Organization: Recommendations on wheat and maize flour fortification. Meeting Report: Interim Consensus Statement. 2010. Accessed at: http://www.who.int/nutrition/publications/micronutrients/wheat_maize_fort.pdf
43. Peterlik M, Boonen S, Cross HS, Lamberg-Allardt C: Vitamin D and calcium insufficiency-related chronic diseases: an emerging world-wide public health problem. Int J Environ Res Public Health 6:2585–2607, 2009.
44. Gennari C: Calcium and vitamin D nutrition and bone disease of the elderly. Public Health Nutr 4:547–559, 2001.
45. Filner JJ, Krohn DK, Lapidus JA, Becker TM: Risk factors for osteoporosis in Alaska Native women: a cross-sectional survey. Alaska Med 44:8–13, 2002.
46. Cummings SR, Nevitt MC, Browner WS, Stone K, Fox KM, Ensrud KE, Cauley J, Black D, Vogt TM: Risk factors for hip fracture in white women. Study of Osteoporotic Fractures Research Group. N Engl J Med 332:767–773, 1995.
47. Behavioral Risk Factor Surveillance Survey (BRFSS) State of Alaska Department of Health and Social Services: Report Alaska Behavioral Risk Factor Survey. 2009. Accessed at: http://www.hss.state.ak.us/dph/chronic/hsl/brfss/pubs/BRFSS06.pdf

48. Ignarro LJ, Balestrieri ML, Napoli C: Nutrition, physical activity, and cardiovascular disease: an update. Cardiovasc Res 73:326–340, 2007.
49. Cochran PA, Marshall CA, Garcia-Downing C, Kendall E, Cook D, McCubbin L, Gover RM: Indigenous ways of knowing: implications for participatory research and community. Am J Public Health 98:22–27, 2008.
50. Ebbesson SO, Ebbesson LO, Swenson M, Kennish JM, Robbins DL: A successful diabetes prevention study in Eskimos: the Alaska Siberia project. Int J Circumpolar Health 64:409–424, 2005.
51. Sharma S: Assessing diet and lifestyle in the Canadian Arctic Inuit and Inuvialuit to inform a nutritional and physical activity intervention programme. J Hum Nutr Diet 23:S5–S17, 2010.
52. Bains A, Pakseresht M, Roache C, Beck L, Sheehy T, Gittelsohn J, Corriveau A, Sharma S: Healthy Foods North improves diet among Inuit and Inuvialuit women of childbearing age in Arctic Canada. J Hum Nutr Diet, 27:175-185 2013.
53. Hopping BN, Mead E, Erber E, Sheehy T, Roache C, Sharma S: Dietary adequacy of Inuit in the Canadian Arctic. J Hum Nutr Diet 23:S27–S34, 2010.
54. Erber E, Hopping BN, Beck L, Sheehy T, De Roose E, Sharma S: Assessment of dietary adequacy in a remote Inuvialuit population. J Hum Nutr Diet 23:S35–S42, 2010.

Received October 15, 2013; revision accepted January 10, 2014.