SPRINGTIME MACRONUTRIENT INTAKE OF ALASKA NATIVES OF THE BERING STRAITS REGION: THE ALASKA SIBERIA PROJECT

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ABSTRACT

Objectives. The diet of Alaska Natives is a complicated mix of native and imported foods. Dietary intake, which may have changed considerably in the past several decades, has important implications for risk of chronic disease. The objective of this study was to add to the knowledge of dietary intake of Alaska Natives of the Bering Straits Region by describing the macronutrient intake of adults.

Study Design. Observational study of dietary intake.

Methods. A 24-hour dietary recall was administered among all consenting, non-pregnant residents of four villages, aged 25 years, or more.

Results. Data are presented for 209 men and 225 women, who represent 48% of eligible participants. Dietary intake was higher in proportion of energy from protein and lower in proportion of carbohydrate than non-Hispanic white Americans overall. Higher energy and protein intakes were reported for men. Comparisons were also made among Alaskan ethnic groups and previous Alaskan surveys.

Conclusion. This study of diet among Alaska Natives demonstrates consistency with other recent work. Differences in diet from earlier 20th century observations, such as higher carbohydrate and lower protein intake, are consistent with documented acculturation in Alaska and other circumpolar regions. *(Int J Circumpolar Health 2005;64(3):222-233.)*

Keywords: dietary intake, Alaska Natives, macronutrient

INTRODUCTION

The influx of western foods into Greenland, Canada, Russia and Alaska has been documented over the past century (1,2). Previously, traditional diets were characterized as low in carbohydrate and high in protein (3,4). Currently, the complexity of the diet of Alaska Natives makes assessment difficult across many ethnic groups, geographic areas, and levels of association with outside cultures. Energy-dense, nutrient-poor foods, high in fat, sugar and salt have been identified by the WHO as the primary nutritional determinants responsible for the increase in chronic diseases observed throughout the world (5). A thorough understanding of the current dietary intake, however, becomes more important as increases in the prevalence of chronic diseases are documented in developing populations. The objective of this paper is to add to the knowledge of the current dietary intake of Alaska Natives of the Norton Sound area by describing the macronutrient intake of adults.

METHODS

This portion of the Alaska Siberia Project (ASP) was a cross-sectional survey of four villages in the Bering Straits Region of northwestern Alaska conducted in April-May 1994. Village councils were consulted about the proposed study, as was the Board of the Norton Sound Health Corporation, which provides direct health-care and other related services to Native residents of the region. Enthusiastic support lead to the selection of four villages of approximately the same size (about 550 individuals). These villages were selected in order to include the three major ethnic groups in the area, with each village largely representing one Eskimo ethnic group, including Inupiat, Central Yupik and Siberian Yupik ethnic groups. The protocol for data collection was based on a pilot study that took place in September 1992. Due to the high cost of travel in rural Alaska, only one survey trip could be made. The springtime was selected, as travel is difficult and unpredictable in the winter, and residents are more likely to be out of the village fishing, or hunting in the summer and fall. The study was approved by the Institutional Review Boards of the University of Alaska, the Indian Health Service and Johns Hopkins University.

A list of names, genders and birthdates of residents was determined from Centers for Disease Control and village council lists, which were updated after conferring with residents. All non-pregnant residents aged 25 years, or more, and who were currently living in the village, were eligible to participate. Those who were temporarily out of the village (≤ 6 months) were eligible to participate, but were not interviewed. Dietary data for this study were collected during house-to-house interviews. The principal investigator of the project initially walked door-to-door recruiting residents to participate. Interviewers returned to the house the following day to conduct the dietary interviews, which took from 1 to 2 hours. Included in that interview was a 24-hour recall, which was collected for this project using the Nutritional Data System (NDS) (6), a software product run on laptop computers. Ten interviewers were selected and trained, including two team leaders (dietitians), two additional dietitians, and six interviewers who were local to the

villages and had no formal nutrition training. Local interviewers conducted several interviews with subjects who spoke only their native language, many of whom were elders. The training consisted of the following: 1) an overview of the data collection process, 2) the use of the laptop computers, 3) the use of questionnaires and 4) a review of appropriate and inappropriate interview methods. Each interviewer was observed by one of the team leaders to complete a full interview in the completion of training and once in the field.

The dietary intake data were translated into nutrient intakes using the NDS System. Although many Alaska Native foods were present in the database, 26 foods from the subjects' food lists were not on the pre-existing lists (Table I). These foods, reported infrequently among all surveys, were matched to appropriate foods in the database, as recommended by the University of Minnesota Nutrition Coordinating Center, and were then entered as recommended within the appropriate 24-hour recall. Daily nutrient intakes reported by NDS for each subject were imported into SAS (SAS Institute, Cary, NC) for statistical analysis. Nutrients of interest included total energy in kilocalories per day, protein, carbohydrate, fat, saturated fat, and monounsaturated and polyunsaturated fat, in grams per day, and percent energy as protein, carbohydrate and fat.

Table I. Foods from 24-hour recalls that were missing from the NDS database.

FOOD
Dried Moose Meat
Dried Tom Cod
Fried Caribou Liver
Dried Caribou
Caribou Tallow
Broth from Reindeer Feet
Reindeer Feet
Chum/King Salmon, Soaked in Brine then Boiled
Dried Bearded Seal
Caribou Ribs
Oogruk, Dried and Stored in Seal Oil
Boiled Walrus Intestines
Boiled Bearded Seal
Steamed Walrus Flippers
Walrus Heart
Yearling Meat Soup
Yearling Walrus
Wild Greens with Seal Blubber and Meat
Whale Gum
Boiled Murre
Walrus Soup
Whale Bone
Dried Aged Baby Walrus (Gasiiqaq)
Dried Baby Walrus
Salmon Roe
Whale Nostril (Tatneq)

Of the 497 eligible men and 402 eligible women, 24-hour dietary recalls were conducted with 227 men (46%), and 239 women (59%). For the 7% of interviews where there was no computer availability or a malfunction (30 of 456), 24-hour recall data were recorded on paper, using the same procedures, but without computer-generated prompting of detailed questions. Eighteen Inupiat subjects were excluded from further data analysis, because they were interviewed after a holiday, which was not representative of usual intake. Data was excluded from analyses for five subjects due to inconsistencies, or concerns noted by the interviewer, and eleven subjects due to missing data, resulting in a final sample size for analysis of 208 men and 225 women. Age and ethnic group affiliations of the final sample are presented in Table II.

The distribution of each variable was assessed. The ability of each variable to conform to a normal distribution was evaluated by visual examination of histograms,

and by the Kolmogorov test for normality. To improve the conformity to a normal distribution, several transformations were used. The natural log transformation was used for the following variables: energy, protein, carbohydrate, fat and the "percentage of energy as protein". No transformation was used for the variables "percentage of energy as carbohydrate" and "percentage of energy as fat". For presentation, variables were converted back to the original units, unless otherwise stated in the text, or tables.

The dietary intake was examined by age, gender and ethnicity in generalized linear models. Age was entered as a continuous variable in a simple linear regression. Dietary differences between genders and ethnic groups were assessed after adjustment for age. In each separate model, age was entered first, and either gender, or ethnicity, was entered second into an analysis of variance model. The Tukey multiple comparisons procedure was used for each ethnicity model to minimize the possibility of type II error. Statistical significance was associated with a P value < 0.05 for the type I sums of squares reflecting the effect of gender after accounting for the effect of age.

A full model was initially constructed using hierarchical modeling in the presence of all main effects variables (age and gender, or age and ethnicity). For each interaction term, significance was liberally defined at a $p < 0.15$, (probability of a greater F value) for the F value for the specific term in the presence of all other variables. Any significant interaction terms were explored.

These data were compared with the dietary intake of non-Hispanic white subjects in early reports from the National Center for Health Statistics for the third National Health and Nutrition Examination Study, NHANES III (7). For each gender, direct age standardization was employed, which used the mean age-specific intake from this study with the age distribution of the NHANES III data. Standard errors of the differences between ASP age-adjusted mean nutrient intakes and NHANES III mean intakes for each nutrient were calculated under the assumption that the variances were unequal (8). T-tests were calculated based on the difference between NHANES III overall nutrient means for ages 20 and older, and the overall age-adjusted ASP mean nutrient intakes.

The ASP data were also compared with the dietary intake of Alaska Native subjects of the 1987-88 survey reported by Nobmann et al. (9). For each gender, age adjustment was repeated for this comparison as with National Center for Health Statistics (NHANES III) data. Direct age standardization was accomplished by use of the mean age-specific nutrient intake from ASP with the age distribution of the 1987-88 survey data. Standard errors of the differences and t-tests were then calculated to make statistical comparisons between surveys.

RESULTS

Participation in the dietary interview was higher for subjects who were older and female. Age group was significantly associated with participation in the 24-hour recall ($p < 0.05$). When considered for each gender separately, this association was evident for women ($p < 0.05$), but not for men. Women were more likely to participate than men ($p < 0.05$).

Table II. Age group and ethnic identity of participants of the Alaska Siberia Project: number and percent.

	WOMEN		MEN	
	N	%	N	%
Age Groups				
25-44	121	54	125	60
45-64	62	28	59	28
65+	42	18	25	12
Total	225	100	209	100
Ethnic Groups				
Centeral Yupik	50	22	47	23
Inupiaq	40	18	35	16
Siberian Yupik	135	60	127	61
Total	225	100	209	100

For each ethnic group, the percentage of eligible residents that participated in the dietary portion of the study was as follows: for men, 55% for Central Yupik, 35% for Inupiat, and 41% for Siberian Yupik, and for women, 72% for Central Yupik, 41% for Inupiat and 58% for Siberian Yupik. The overall participation differed by ethnic group with the Central Yupik group having the highest participation (63%) and Inupiat subjects the lowest (38%). Differences in participation among ethnic groups were significant for both genders combined ($p < 0.05$), for women ($p < 0.05$), and for men ($p < 0.05$).

Dietary energy, carbohydrate and percentage of energy as carbohydrate declined with increasing age for both genders (data not shown). The percentage of energy as protein increased with each additional year for ASP subjects, by 0.16% for men and by 0.20% for women. Polyunsaturated fat intake decreased with increasing age for women (0.12% per year), but not significantly for men. No consistent differences with increasing age were observed for absolute quantity of protein, or fat intake, percentage of energy as fat, or for monounsaturated and saturated fat intake.

Differences between men and women in nutrient intake were considered for all nutrients, and are shown in Table III. For all ethnic groups considered together, men consumed significantly more energy ($p < 0.01$) and protein ($p < 0.01$) than women in both crude and age-adjusted analyses, and a higher percent of calories from protein ($p < 0.05$) than women only after age adjustment (not shown). No significant gender differences were found for carbohydrate, fat percentage of energy as carbohydrate, percentage of energy as fat, saturated fat, monounsaturated fat and polyunsaturated fat.

Differences between ethnic groups in age-adjusted nutrient intake were examined for all nutrients. In crude and age-adjusted analyses, energy and carbohydrate intakes were higher for female Inupiat participants than for either Central Yupik, or Siberian Yupik women, and protein intakes were higher among Inupiat than Siberian Yupik women, but these differences were not found for men. The percentage of energy from protein was higher for Siberian Yupik women compared with Yupik women, but the difference did not persist after age adjustment. The percentages of energy as carbohydrate were significantly lower for Siberian Yupik than for Inupiat, or Central Yupik participants of both genders, both before and after age adjustment. Saturated and polyunsaturated fat intakes were higher among Yupik women compared with Siberian Yupik women. After age adjustment, these differences in fatty acid intake persisted. No differences in fatty acid intakes were found for men among the different ethnic groups.

Table III. Nutrient intake from a single 24-hour recall by ethnic group and gender.

	Central Yupik		Inupiat		Siberian Yupik		All Ethnic Groups	
Nutrient (units)	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
Women	n=50		n=40		n=135		n=225	
Energy (kcal) [ab]	1871	1076	2516	1576	1727	1099	1899**	1222
Energy (kj)	7857	4520	10568	6618	7253	4615	7977	5134
Protein (g) [b]	97	71	125	137	89	71	97**	87
Carbohydrate (g) [ab]	203	123	294	158	171	132	200	142
Fat (g)	76	57	95	83	75	59	79	64
Protein (% of energy) [b]	22	11	18	11	23	12	22	12
Carbohydrate (% of energy) [bc]	45	16	50	17	39	17	43	17
Fat (% of energy)	34	10	33	12	37	14	36	13
SFA (g) [b]	23	19	29	29	20	18	22	21
MFA (g)	31	24	37	33	34	28	34	28
PFA (g) [ab]	15	14	21	17	14	13	15	14
Men	n=47		n=35		n=127		n=209	
Energy (kcal)	2274	1102	2477	1656	2216	1579	2273	1496
Energy (kj)	9550	4629	10404	6956	9306	6632	9545	6281
Protein (g)	123	84	156	277	121	90	127	138
Carbohydrate (g)	252	187	275	133	214	227	233	206
Fat (g)	85	57	85	56	94	79	90	71
Protein (% of energy)	23	11	21	12	25	14	24	13
Carbohydrate (% of energy) [bc]	45	19	48	14	37	17	41	18
Fat (% of energy)[b]	32	14	31	10	37	14	35	14
SFA (g)	26	21	27	20	25	20	25	20
MFA (g)	34	23	33	22	43	40	39	34
PFA (g)	17	13	16	10	19	18	18	16

Significant differences of $p<0.05$ are denoted by [a] = Inupiat – Central Yupik, [b] = Inupiat – Siberrian Yupik , and [c] = Central Yupik – Siberian Yupik. SFA = Saturated Fatty Acids, MFA, = Monounsaturated Fatty Acids, PFA = Polyunsaturated Fatty Acids. For Gender Differences * <0.05, **<0.01, ***<0.001.

Comparison of ASP with NHANES III American non-Hispanic whites (7) yielded several differences in dietary intake (Table IV). For women, ASP subjects consumed significantly more protein and a higher proportion of energy as protein, but a lower proportion of energy as carbohydrate, than NHANES III whites. For men, ASP subjects consumed a significantly higher proportion of energy as protein, but significantly less carbohydrate, and a lower proportion of energy as carbohydrate and saturated fat.

Differences were found only for men between ASP intake and that of the 1987-88 survey among Alaska Natives ($p < 0.02$, Table V). Women surveyed in ASP consumed the same amount of energy and macronutrients as were reported by Nobmann et al. in 1987-1988 (9). The men surveyed in ASP, however, consumed significantly less fat compared to those in the Nobmann et al. study (9).

Table IV. Dietary nutrient intake of NHANES III non-Hispanic white and ASP (Age Adjusted to NHANES III), mean, standard error, pooled standard error, and t-test.

	Adjusted ASP		NCHS		Pooled		
	Mean	SE	Mean	SE	SE	t-test	p value
Women	n=225		n=1718				
Energy (Kcal)	1755	192	1661	43	197	0,476	ns
Energy (KJ)	7370	807	6976	179	827		
Protein (g)	95	15	63	2	15	2,197	< 0.05
Carbohydrate (g)	182	23	207	6	24	-1,070	ns
Fat (g)	71	10	64	2	10	0,714	ns
Protein (% energy)	23	2	16	0	2	3,559	< 0.001
Carbohydrate (% energy)	41	3	51	1	3	-3,109	<0.001
Fat (% energy)	35	2	33	1	2	0,718	ns
Saturated Fatty Acids (g)	20	3	22	1	3	-0,549	ns
Monounsaturated Fatty Acids (g)	31	4	23	1	5	1,683	ns
Polyunsaturated Fatty Acids (g)	14	2	14	1	2	-0,099	ns
Men	n=209		n=1763				
Energy (Kcal)	2105	253	2396	65	260	-1,12	ns
Energy (KJ)	8843	1061	10064	274	1092		
Protein (g)	123	26	90	2	26	1,28	ns
Carbohydrate (g)	203	33	284	9	34	-2,37	<0.02
Fat (g)	87	13	94	3	13	-0,50	ns
Protein (% energy)	25	2	15	0	2	3,90	<0.001
Carbohydrate (% energy)	40	3	48	1	3	-2,48	<0.02
Fat (% energy)	35	3	34	1	3	0,05	ns
Saturated Fatty Acids (g)	24	4	32	1	4	-2,14	<0.05
Monounsaturated Fatty Acids (g)	38	6	35	1	6	0,51	ns
Polyunsaturated Fatty Acids (g)	17	3	19	1	3	-0,73	ns

Table V. Comparison of caloric and macronutrient intake for this study (1994) and Nobmann (1987-88): Mean and standard error for each nutrient, combined standard errors by nutrient, and t-test.

	Adjusted ASP 1994		Nobmann, et al. 1987-88		Pooled		
	Mean	SE	Mean	SE	SE	t-test	p value
Women							
n	180		186				
Energy (Kcal)	1995	185	1945	55	185	0,27	ns
Energy (KJ)	8380	777	8169	231	777		
Protein (g)	100	14	90	3	14	0,71	ns
Carbohydrate (g)	212	22	214	8	22	-0,09	ns
Fat (g)	83	9	81	3	10	0,17	ns
Men							
n	182		165				
Energy (Kcal)	2406	231	2754	84	231	-1,51	ns
Energy (KJ)	10104	970	11567	353	970		
Protein (g)	133	23	127	6	23	0,24	ns
Carbohydrate (g)	256	33	282	10	33	-0,79	ns
Fat (g)	93	10	117	5	10	-2,35	<0.02

DISCUSSION

Perspectives on the continuing change in diet of Alaska Natives of the Norton Sound Area are provided in this study, through the description of the macronutrient dietary pattern resulting from the change in a traditional subsistence food pattern after a century of influence from the western world. Overall, a higher proportion of energy as protein was found for men, older subjects and for the Siberian Yupik participants. This is similar to the findings of the pilot study among Siberian Yupik in autumn, 1992 (10). The common agent is likely to have been less incorporation of western foods within these subgroups of our study. Historic changes in diet with western influence mirror these observations.

Historically, indigenous people of the circumpolar North throughout Alaska, Canada, Russia and Greenland, who have been known as northern "Eskimos", or Inuit, were observed to eat a diet consisting of fish, meat and fat, with a small amount of plant matter when available (11). Before western influence, macronutrient intake was estimated to include 45% of energy each as protein and fat, and approximately 10% of energy as carbohydrate (3,4). From these estimates, protein intake appears to have been very high, as would be expected from a meat-based diet, and carbohydrate intake was extremely minimal (3,4). Since those early estimations, a lower proportion of energy as protein and a higher proportion of energy from carbohydrate were observed in studies of modern communities, when compared with those of communities still living a "traditional" lifestyle within Inuit, or northern "Eskimo" populations from Alaska, Canada and Greenland (1).

Like the studies reported by Schaefer (1), dietary surveys of Alaska Natives from the 1940s and 1950s reported a pattern of intake through a mixed diet of traditional and imported foods that was very different from the estimated traditional diet (12). Flour, sugar and butter, among other foods, were introduced after contact with western explorers and traders. Carbohydrate intake was clearly higher in modern studies than was previously known for Eskimos (11, 13). This fact is corroborated by the state of dentition, which was once remarkably good, but became a public health priority as carbohydrate intake increased (13,14).

The diet of four northern "Eskimo" villages was surveyed from 1956-1961 (12), two of which were followed up in 1971-1972 (15). Decreases in energy from protein were observed for both villages, but the changes in carbohydrate and fat were inconsistent between the villages, and difficult to interpret, as statistical tests were not applied to differences between villages, or between surveys.

Surveys of Alaska Natives continued in 1987-1988, when Nobmann et al. (9) evaluated 24-hour recalls of 165 men, and 186 women from 11 villages throughout Alaska, during four seasons. Nobmann et al. observed an even smaller proportion of protein calories and more carbohydrate intake than those seen in the 1971 Bell and Heller survey (9,15). However, the villages surveyed in 1987-88 included larger transportation and import centers, such as Kotzebue, Bethel, Anchorage and Dillingham (9), and not only the smaller, rural villages included in the earlier surveys.

Much of the change in dietary nutrient intake for Alaska Natives may lie with the increased inclusion of imported foods in the

diet. Bell and Heller (15) commented that the differences between the two villages are "…probably because the Wainwright population makes greater use of native foods that are high in protein and fat and low in carbohydrate. This survey indicates that 34% of calories were obtained from native foods in Wainwright and only 18% in Point Hope."

In recent decades, other circumpolar native communities have undergone great changes in diet that are also associated with an increased intake of imported foods. The Inuit of Baffin Island (Canada) also have a mixed diet of traditional and imported "market" foods (16). Similar to the nutrient differences seen in Alaska, Kuhnlein et al. (16) found that market foods contributed significantly more carbohydrate and polyunsaturated fats in all age groups and more saturated fat in subjects over 60 years of age. Traditional foods contributed significantly more protein. Similar findings have more recently been observed by Kuhnlein et al. among Yukon and Dene/Metis populations, as well as the Inuit (2).

In our 1994 survey, differences were observed between ethnic groups, which may be accounted for by differences in western influence, or the season of survey, or both. It must be noted that two of the ethnic groups are each represented by only one village, and the third ethnic group by two villages. Many of the differences recognized by this analysis as "ethnic group" differences may be due to differences in the geography, or economy of that village, and are not necessarily representative of the entire ethnic group. Central Yupik and Inupiat subjects in this report reside in coastal villages, which may have had more consistent contact and trade with western society than the island villages of the Siberian Yupik participants. The villages that participated in this project were chosen to be of a relatively moderate size, which may best represent the diverse sizes of villages in the area. However, because there is not a larger sample of springtime dietary intake for any of these ethnic groups, the representative nature is not clear.

Differences between the ethnic groups in this study may also reflect the very slight seasonal differences in data collection. During the April data collection for Inupiat and Central Yupik participants, the villages were still very frozen, whereas the May data collection for Siberian Yupik participants saw much snow melting and the beginnings of the ice break-up. More game is hunted in the late spring, including bearded seals and walrus which come up onto the ice as the ice flows melt. Also, data collection for Siberian Yupik subjects took place as the whaling season came to an end. Native food availability is not affected by the whaling season in either coastal village, as those residents do not hunt whales, although other seasonal foods may have an influence.

In the 1987-1988 survey, springtime energy, protein and fat were significantly lower than in other seasons for both genders (9). If the same seasonal differences hold in the Bering Straits region, the mean values for these nutrients reported in this study may be lower than the true yearly averages.

The women surveyed in ASP consumed a diet similar to that of the Alaska Native women surveyed in 1987-1988 (9), some of whom were from more urbanized areas, and were surveyed in both spring and in higher consumption seasons. Within ASP, the men

consumed more energy, protein and, among Siberian Yupik, a greater amount of fat than the women in this study. Men also consumed a higher proportion of energy as protein.

A higher intake of energy and other nutrients would certainly be expected in men, due to larger body sizes, although the differences in energy and protein intake by gender persisted after adjustment for body weight (data not shown). However, it appears that, as a group, women have adopted a more acculturated lifestyle than men, by eating somewhat fewer protein calories and taking less physical activity (data not shown), resulting in somewhat higher body fat (17).

Similar gender differences in lifestyle have been documented in Siberia. Katzmarzyk et al. (18) documented sedentary activity patterns in Siberian women, while men remained much more active. In a comparison of nGanasan (Siberian) and Igloolik (Canadian) Inuit, Rode and Shephard (19) also documented similar skin-folds for women from each community, but Siberian men were much leaner compared with the Igloolik.

Dietary macronutrient intake differed in this study with increasing age. Older subjects had lower energy, carbohydrate and polyunsaturated fat intake. Fat intake also declined with age for Siberian Yupik subjects. Also, to a smaller extent, the proportion of energy from protein increased with age.

Similar differences between older and younger subjects have been found in previous surveys of diet in Alaska Natives. In response to an observation of generational dietary differences, Heller (20) recommended a diet for adolescents that was higher in meat and fish, and lower in pancakes, candy and pop. Totter and Shukers (14) noted that good teeth were still evident in older residents who still practiced a traditional diet, whereas younger subjects had excessive cavities. Of course, the adolescents of the late 1940s are the older adults of the 1990s. Also, in recent years in western Alaska, Eskimos older than 30 years were found to consume significantly higher snack-related carbohydrate compared with Eskimos over 60 years old (21).

Differences with age in this cross-sectional survey may reflect both differences in the life experiences of older and younger subjects, and the changes that may occur during aging. Certainly, the elders of these rural villages must have experienced different lifestyles than those of today, as snowmobiles and televisions have become a common part of the rural Alaskan lifestyles of today. The surveyors of diet during the youth of these elders, however, found the same concerns of too much sugar and too little native foods voiced by both the elders and the nutritionists today. Although some imported foods are more available now, and small changes in the macronutrient patterns of adults have occurred over the past several decades, the differences in food choices between older and younger residents are more marked, and seem to have been consistent over the last forty years.

Limitations to the data collection methods and study design must be examined upon interpretation of these findings. An interviewer response bias must be considered, as the local interviewers conducted many of the interviews of the elders. The local interviewers were trained by the research team only, with no additional formal education in nutrition, or interviewing. It is possible that a respondent might answer questions differ-

ently for an interviewer from outside of the village compared with someone from within the village. Seasonality strongly limits the generalizability of this data, but the numbers of subjects surveyed are large compared to previous dietary surveys in the area.

Study participation could certainly also limit the interpretation of these results, especially for men. If under-represented subjects were mostly young men engaged in hunting or employment at the time of the survey, one might expect their energy intake to be higher than that of the participants. Another interpretation might be that young men that hunt, or are employed, might have more native food sources, or cash for buying groceries (i.e. energy intake). The relative probability of either of these scenarios is not known, but it could certainly limit the extrapolation of these data to the under-represented groups. Our experience of a greater participation among women is similar to that reported in the Strong Heart Study (22).

The implications of the observed diet for Alaska Natives are unclear. Dietary intake has been associated with disease risk and biochemical markers of disease risk in other circumpolar communities. Nikitin compared inland Chukchi and coastal Eskimo men, and found that the proportions of energy as protein and carbohydrate were related to risk factors for heart disease (23). Carbohydrate intake was higher in subjects with dyslipoproteinemias than in subjects without (23). Similar findings were found for glucose intolerance among Central Yupik and Indian Alaska Natives with, who consumed more non-indigenous protein and white bread, and in the euglycemic subjects, who consumed more salmon/fish and seal oil (21).

CONCLUSIONS

This study is consistent with other observations of dietary intake in circumpolar regions made during the last 60 years. The trend of decreasing protein and increasing carbohydrate as a pattern of change with acculturation seems to be consistent among indigenous peoples throughout the circumpolar north, including the differences between observations in this study as compared with previous research. The change in macronutrient intake of Alaska Natives of the Norton Sound Area appears not to have been drastic over the last several decades. However, it appears that women have been especially affected by the influx of elements of a western lifestyle into Eskimo culture.

Although early changes from the pre-contact estimations to the 1956-1961 study were abrupt, the dietary pattern in the rural villages of ASP is still very different from that of the general U.S. diet. The effects of the constant influence of western culture on Eskimo diet and lifestyle are still difficult to assess. Adult residents of the Norton Sound Area have presumably lived their entire life on a mixed diet of native and imported foods. The health consequences of this macronutrient pattern may become evident upon further investigation of this population, both now and as acculturation continues.

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