Alaska Native Traditional Food and Harvesting Activity Patterns over 10 Years of Follow-Up

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ABSTRACT

Background: Alaska Native (AN) traditional foods and associated harvesting activities are beneficial to human health.

Objective: This study assessed longitudinal self-reported traditional food use and harvesting activities among Alaska Native and American Indian (AN/AI) participants in the Alaska Education and Research Towards Health (EARTH) study.

Methods: In 2004–2006, southcentral Alaska EARTH study participants (n = 1320) completed diet and activity questionnaires which were repeated in 2015–2017; results were compared between participants who completed both questionnaires (n = 388).

Results: In the follow-up questionnaire, >93% of participants reported eating ≥1 traditional food in the past year. The top 3 traditional foods were fish (75%), moose (42%), and shellfish (41%). Women were more likely than men to consume traditional foods, especially fish, gathered berries, shellfish, and seal oil (P < 0.05). Participants aged ≥60 y in the original cohort were significantly more likely to consume fish and shellfish at follow-up, whereas those aged 40–59 y were the most likely of the 3 age groups to consume seal oil (P < 0.05). Between the original cohort and follow-up, there was a significant decline in the mean number of traditional foods eaten from 6.3 to 5.5, as well as reduced consumption of multiple traditional foods (P < 0.001). Over 59% of participants reported ≥1 traditional harvesting activity in the past year; this proportion did not significantly change between baseline and follow-up. Picking berries/greens (44%), cutting/smoking fish or meat (33%), and fishing (30%) were the most common activities. Participation in traditional harvesting activities was greater among women than men (P < 0.05), but did not differ by age.

Conclusions: Longitudinal follow-up demonstrated that AN/AI people maintained participation in traditional harvesting activities, but the variety of traditional foods declined significantly among both men and women. Promotion of traditional foods and harvesting activities that serve as protective factors against chronic diseases may benefit this population.

Introduction

Alaska Native (AN) traditional foods and the harvesting activities required to obtain them are beneficial to human health (1–10). Historically AN people harvested and subsisted upon foods from the local environment. However, since Western contact there has been a decline in the reliance on traditional foods and harvesting activities in the AN lifestyle and an increase in the use of commercial, processed or store-bought foods (7, 11–18). Simultaneously, AN people have experienced an increase in the prevalence of chronic diseases, including obesity, diabetes, cardiovascular diseases, and cancers, which are often associated with the Western diet (1, 19–28).
The Education and Research Towards Health (EARTH) Study is a multicenter cohort study designed to investigate risk and protective factors for chronic disease among Alaska Native and American Indian (AN/AI) people. Participants were recruited in 2004–2006 from 3 regions in Alaska (southcentral, southeast, and southwest). A main focus area of this study was diet and physical activity, which included traditional AN wild-harvested foods and harvesting activities. In the original cohort analysis in the 3 regions, >92% of participants reported eating ≥1 traditional food in the past year with the top traditional foods reported being fish, moose, and aguq (a mixture of berries and fat). Use of traditional foods varied by region, with the southwest region reporting the most traditional foods consumed, and also by age, with older participants aged ≥55 y reporting more use of traditional foods than younger participants. Reported participation in traditional harvesting activities was high in the original 3-region cohort, with almost 70% of participants participating in ≥1 traditional harvesting activity. Picking berries or greens, cutting/smoking fish or meat, and fishing were the most common activities. Similarly to traditional food consumption, participation in traditional harvesting activities was highest in southwest Alaska. Traditional harvesting activities were significantly higher among men than among women in the original 3-region cohort, but did not differ by age. The original cohort study also found that respondents who reported greater use of traditional food and harvesting activity also reported significantly greater tribal self-identification and were more likely to speak a Native language at home, use traditional remedies, or participate in or attend traditional events (29).

Although several studies have presented cross-sectional data showing a decrease in traditional food use and physical activities by AN people since the 1950s (2, 4, 8, 14, 15), as far as we know no studies to date have examined time trends in a defined cohort of AN people. From 2015–2017 a subset of the original Alaska EARTH study participants recruited in 2004–2006 from the southcentral Alaska region participated in a follow-up study visit (Figure 1). Here we describe changes in traditional food use and physical activities associated with harvesting traditional foods (hereafter referred to as harvesting activities) reported by southcentral region EARTH study participants at follow-up.

Methods

Study population

The study design, survey methods, and measurement instruments for the original EARTH study cohort (2004–2006) have been reported previously, including the methods used to collect dietary and physical activity data (29–33). Briefly, the original Alaska EARTH study cohort was comprised of participants from 26 communities in 3 regions of Alaska. Enrollment criteria included AN/AI race and eligible for health care through the Indian Health Service; ≥18 y of age; physically and mentally able to give informed consent and complete study activities; not currently pregnant; and not currently receiving chemotherapy. Deferred enrollment was offered to participants who were pregnant (until 3 mo postpartum) or actively undergoing cancer treatment (until 1 y after completion of cancer treatment).

The follow-up cohort (2015–2017) included only AN/AI people from the southcentral region, who live in or around Alaska’s largest urban area (Anchorage/Matnuska-Susitna Valley, total population ∼380,000; AI/AN population ∼57,500 or ∼35% of the statewide AI/AN population) (34). Because this area is an employment and education center for the state, numerous tribal groups were represented in the follow-up cohort, including Yup’ik, Inupiaq, Athabascan, Unangan (Alek), and Tlingit/Haida/Tsimshian, as well as AI people from the contiguous United States. Contact information provided at the original cohort study visit as well as electronic medical record data were used for follow-up recruitment, which included multiple contact methods: telephone, postal and email mail, and in-person encounters. Members of the AN community worked as study members, and data were collected at AN community health locations. As in the original cohort study, participants were provided incentives for participation, including a health risk assessment at the conclusion of the study visit. Deceased participants, identified using state vital statistics records, were excluded from recruitment efforts (35).

Ethics

This study was approved by the Alaska Area Institutional Review Board and the Tribal research review and approval entities for the Alaska Native Tribal Health Consortium and Southcentral Foundation. All participants provided informed consent. This study was not a clinical trial and therefore did not need to be registered.

Data collection

Participants completed diet and physical activity questionnaires by using computer-assisted self-interview on touch-screen panels while listening to an audio version of the questionnaire (36). Self-reported demographic data were also collected.

Diet measurement.

The EARTH Diet History Questionnaire (DHQ) has been previously described (32). The questionnaire includes foods commonly eaten by the general US population as well as an AN traditional foods list based on Tribal leadership and local AN expert knowledge. Traditional foods were defined as foods locally hunted, harvested, fished, and gathered in Alaska, including seafood, game meat, marine mammals and their fats, berries, greens, and wild birds and bird eggs. There were 27 traditional foods incorporated into the EARTH DHQ: smoked or dried fish; hooligan or herring; other fish such as halibut or char (not smoked or dried); herring eggs; canned or jarred salmon; shellfish; muskox; caribou; deer; moose; reindeer; buffalo; beaver; rabbit or squirrel; heart or tongue; kidney; intestines or stomach; seal or walrus; muktuk (whale blubber and skin); seal oil; gathered berries; aguq (a mixture of berries and fat); beach asparagus; seaweed or kelp; wild or gathered greens; wild birds; and bird eggs. Participants reported if they ate each food at least once a month or ≥12 times in the past year to assess both frequency as well as the variety of foods consumed. The EARTH DHQ was validated using repeated 24-h diet recalls and found to have acceptable relative validity for use in epidemiologic studies (31).

Physical activity measurement.

Harvesting activity was defined as activity related to traditional food procurement or harvesting. Harvesting activities included berry
picking, fishing by hand or with a set net, hunting marine mammals, hunting big or small game, trapping, butchering game, cutting and/or smoking fish or meat, and working on animal skins or tanning hides. The EARTH study physical activity questions were adapted from the Multi-Ethnic Study of Atherosclerosis and the Taylor physical activity questionnaires (37, 38).

Statistical analysis
Summary statistics were calculated to provide an overview of the demographic characteristics of the Alaska southcentral EARTH study follow-up participants as compared with the original southcentral cohort at baseline. Among follow-up participants, the percentages of respondents reporting any mention of each of the 10 most common traditional foods (i.e., fish, moose meat, agutaq, gathered berries, herring eggs, shellfish, caribou, seal oil, seal/walrus meat, and wild birds) were calculated and compared with the respondents’ reports at baseline. McNemar’s test was used to determine significant changes in the consumption of each food. The percentages of respondents mentioning consumption of ≥1, ≥7, and ≥10 of 27 traditional foods were also calculated and McNemar’s test was used to determine significant changes in traditional food consumption between baseline and follow-up. Finally, the mean number of the 27 traditional foods mentioned by respondents at baseline was compared with the mean at follow-up. A paired t test was used to test for significant change. Analyses were stratified by age (18–39, 40–59, ≥60 y) and sex, based on age at baseline.

The proportion of respondents who reported traditional harvesting activities was also assessed. Percentages of respondents participating in the original cohort were compared with those at follow-up using McNemar’s test. The proportions of participants reporting consumption of traditional foods and participation in harvesting activities at baseline and follow-up were compared among men and women and between age groups. Chi-square tests were used to determine whether differences were statistically significant. All analyses were conducted using SAS 9.4.
TABLE 1  Comparison of participant characteristics of the southcentral Alaska Education and Research Towards Health study baseline and follow-up cohorts

|                          | Baseline cohort n (%) | Follow-up cohort n (%) | P value\(^1\) |
|--------------------------|-----------------------|------------------------|---------------|
| All participants         | 1320 (100)            | 388 (29.4)             | 0.005         |
| Sex                      |                       |                        |               |
| Female                   | 878 (66.5)            | 280 (72.2)             | 0.005         |
| Age, y                   |                       |                        |               |
| 18–39                    | 647 (49.0)            | 177 (45.6)             | 0.2033        |
| 40–59                    | 593 (44.9)            | 189 (48.7)             |               |
| ≥60                      | 80 (6.1)              | 22 (5.7)               | 0.225         |
| Household size\(^2\) (mean ± SD) | 3.5 (2.2) | 3.4 (2.1) | <0.0001       |
| Education level          |                       |                        |               |
| Greater than high school | 712 (53.9)            | 253 (65.2)             |               |
| Employment status        |                       |                        |               |
| Currently employed or self-employed | 618 (46.8) | 213 (54.9) | 0.0001        |
| Annual income            |                       |                        |               |
| >$15,000\(^3\)          | 758 (64.6)            | 273 (74.8)             | <0.0001       |
| Length of time in residence, y\(^4\) | 514 (39.6) | 150 (39.3) | 0.86          |
| Marital status           |                       |                        |               |
| Married/living as married| 511 (38.7)            | 178 (45.9)             | 0.0006        |
| Language spoken at home  |                       |                        |               |
| English\(^5\)            | 1058 (80.3)           | 332 (85.8)             | 0.009         |
| Self-reported health status |                   |                        |               |
| Excellent/very good/good\(^6\) | 1015 (77.0) | 322 (83.2) | 0.0005        |

\(^1\)Chi-square P value for differences in proportions between southcentral cohort respondents followed up and those unable to be followed up.
\(^2\)Missing household size values for 10 baseline and 1 follow-up participants.
\(^3\)Missing income values for 147 baseline and 23 follow-up participants.
\(^4\)Missing residence values for 23 baseline and 6 follow-up participants.
\(^5\)Missing language value for 2 baseline and 1 follow-up participants.
\(^6\)Missing health status value for 1 baseline and 1 follow-up participant.

Results

Demographic characteristics

Demographic characteristics for the southcentral Alaska EARTH study original cohort (n = 1320) and follow-up participants (n = 388, 29.4% of the original cohort) are shown in Table 1. Women predominated in the follow-up cohort (72%). Over half (55%) of follow-up participants were employed and 75% reported household incomes >$15,000/y. The majority (65%) had a high school education or higher. About 46% were currently married or living as married, and ~14% spoke their AN/AI language at home. More than 83% believed their health to be good to excellent. Statistically significant demographic differences between the baseline and the follow-up cohorts included a larger proportion of women, higher educational attainment, a larger proportion married, currently employed, with income >$15,000, and speaking English at home in the follow-up cohort than in the baseline cohort (29).

Traditional food use

Table 2 shows the top 10 traditional foods reported in the EARTH follow-up study (n = 385). Self-reported traditional foods consumed by the same individuals are compared at both time points (baseline and follow-up). Fish was the most frequently reported traditional food (75%), followed by moose (42%), shellfish (41%), gathered berries (39%), and caribou (27%). Among follow-up participants, women were more likely than men to report eating shellfish, gathered berries, fish, and seal oil (P < 0.05). Older participants (age ≥60 y) were more likely to report eating fish and shellfish than were the other 2 age groups, whereas those aged 40–59 y were the most likely of the 3 age groups to report eating seal oil (P < 0.05). Of the total follow-up study population, 93% reported eating ≥1 traditional food in the past year, 31% reported eating ≥7 different foods, and 16% reported eating ≥10 foods.

At the original southcentral region baseline, the top 3 foods reported were fish, shellfish, and gathered berries. At follow-up, the top 3 foods were fish, moose, and shellfish (Table 2). There was an overall significant decline between baseline and follow-up in the consumption of seal or walrus (23% compared with 10%, P < 0.001) but a significant increase in the reported consumption of moose meat (36% compared with 42%, P = 0.02). There was no statistically significant change in the consumption of the other traditional foods reported. There was also a significant decline in the mean number of traditional food sources eaten from 6.3 to 5.5 (P < 0.001), as well as a reduction in the consumption of multiple traditional foods, with fewer participants reporting eating ≥7 traditional foods (31% compared with 41%, P < 0.001) or ≥10 traditional foods (16% compared with 23%, P = 0.001) at follow-up than at baseline. This trend held for both men and women and there were no significant differences across age groups.
### TABLE 2  Top 10 traditional foods reported consumed by southcentral Alaska Education and Research Towards Health study participants in the past year at baseline and follow-up by sex and age1

| All (n = 382) | Men (n = 105) | Women (n = 277) | 18–39 y (n = 176) | 40–59 y (n = 185) | ≥ 60 y (n = 21) |
|---------------|--------------|----------------|-------------------|-------------------|---------------|
| Fish†         | 284 (74%)    | 77 (71%)       | 209 (75%)         | 122 (69%)         | 146 (77%)     |
| Moose         | 138 (36%)    | 41 (38%)       | 97 (35%)          | 55 (31%)          | 76 (40%)      |
| Agutag        | 80 (21%)     | 24 (22%)       | 50 (20%)          | 34 (19%)          | 32 (19%)      |
| Gathered berries | 149 (39%)    | 33 (31%)       | 116 (42%)         | 63 (36%)          | 79 (41%)      |
| Herring eggs  | 90 (24%)     | 24 (22%)       | 66 (24%)          | 33 (19%)          | 52 (28%)      |
| Shellfish     | 173 (45%)    | 42 (39%)       | 131 (47%)         | 77 (44%)          | 84 (44%)      |
| Caribou       | 109 (29%)    | 32 (30%)       | 77 (28%)          | 42 (24%)          | 61 (32%)      |
| Seal oil      | 69 (18%)     | 18 (17%)       | 51 (18%)          | 25 (14%)          | 40 (21%)      |
| Wild birds    | 56 (15%)     | 18 (17%)       | 38 (14%)          | 24 (14%)          | 31 (16%)      |
| Seal or walrus| 89 (23%)     | 23 (21%)       | 66 (24%)          | 34 (19%)          | 52 (28%)      |

Consumption of multiple traditional foods

≥1 foods | 347 (91%) | 91 (87%) | 256 (92%) | 154 (88%) | 172 (93%) |
≥7 foods | 157 (41%) | 37 (35%) | 120 (43%) | 60 (34%) | 88 (48%) |
≥10 foods | 89 (23%) | 24 (23%) | 65 (23%) | 35 (20%) | 49 (26%) |

Mean ± SD traditional foods eaten

|                | All (n = 382) | Men (n = 105) | Women (n = 277) | 18–39 y (n = 176) | 40–59 y (n = 185) | ≥ 60 y (n = 21) |
|----------------|--------------|--------------|----------------|-------------------|-------------------|---------------|
| Fish†          | 6.3 ± 5.1    | 5.9 ± 5.2    | 6.5 ± 5.0      | 7.1 ± 5.5         | 6.5 ± 3.8        |

1 Fish includes smoked or dried fish (any kind), salmon/hooligan/herring, other fish like halibut or char, canned or jarred salmon, and fish soup. Follow-up sex comparisons: women were more likely than men to consume fish (P = 0.023), gathered berries (P = 0.0008), shellfish (P = 0.03), and seal oil (P = 0.04). Follow-up age group comparisons: participants aged ≥60 y were more likely to consume fish (P = 0.018) and shellfish (P = 0.003), whereas those aged 40–59 y were most likely to consume seal oil (P = 0.02). *P < 0.05.
**Table 3** Number and percentage of southcentral Alaska Education and Research Towards Health study participants reporting traditional harvesting activities at baseline and follow-up by sex and age

| Activity                        | Baseline | Follow-Up | Baseline | Follow-Up | Baseline | Follow-Up | Baseline | Follow-Up | Baseline | Follow-Up | Baseline | Follow-Up |
|--------------------------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| Fishing                        | 120 (32) | 114 (30)  | 42 (30)  | 31 (28)   | 73 (35)  | 66 (36)   | 35 (35)  | 30 (28)   | 29 (30)  | 31 (30)   | 49 (34)  | 34 (29)   |
| Tanning hide                   | 62 (72)  | 60 (74)   | 20 (20)  | 20 (20)   | 14 (14)  | 14 (14)   | 14 (14)  | 14 (14)   | 14 (14)  | 14 (14)   | 14 (14)  | 14 (14)   |
| Trapping                       | 3 (4)    | 3 (5)     | 0 (0)    | 0 (0)     | 0 (0)    | 0 (0)     | 0 (0)    | 0 (0)     | 0 (0)    | 0 (0)     | 0 (0)    | 0 (0)     |
| Marine mammal hunting          | 1 (2)    | 1 (2)     | 0 (0)    | 0 (0)     | 0 (0)    | 0 (0)     | 0 (0)    | 0 (0)     | 0 (0)    | 0 (0)     | 0 (0)    | 0 (0)     |
| Game hunting                   | 37 (10)  | 38 (10)   | 19 (20)  | 20 (20)   | 18 (20)  | 18 (20)   | 18 (20)  | 18 (20)   | 18 (20)  | 18 (20)   | 14 (14)  | 14 (14)   |
| Hunting all others              | 102 (27) | 102 (27)  | 41 (30)  | 41 (30)   | 39 (29)  | 39 (29)   | 39 (29)  | 39 (29)   | 39 (29)  | 39 (29)   | 39 (29)  | 39 (29)   |

**Discussion**

A number of studies have noted a decline in traditional food use among AN people since the 1950s (2, 4, 8, 14, 15), but no studies to date, to our knowledge, have examined time trends in a longitudinal cohort of AN people. Furthermore, traditional harvesting activity patterns over time have been understudied in this population. This study demonstrates changing patterns of traditional food use and harvesting activity among AN people over a 10-y period. The study found that participants maintained involvement in traditional harvesting activities, with a significant increase in picking berries or greens and cutting/smoking fish and meat. In contrast, there was a significant decrease in the consumption of multiple traditional foods among both men and women. There were also differences in the types of traditional foods consumed reported by the southcentral cohort over the follow-up period, including an increase in the consumption of moose and a decline in the consumption of seal or walrus.

Several factors might be involved in the changes observed, including social influences, such as sharing food among families or within communities and teaching traditional food harvest and preparation skills to younger generations, or environmental influences (18, 39, 40). These might be important factors that contribute to the decline in traditional food use reported at follow-up. The high cost and amount of time needed for hunting, harvesting, and processing traditional food may also play a role. Additional factors are changing patterns in the abundance of game over the 10 y of follow-up, as well as state and federal regulations governing use of subsistence foods, which may restrict access to traditional harvest locations or species (41). A further possible determinant is that the effects of climate change in the Arctic, including the appearance of new disease species, increasing water temperatures, and the appearance of new disease species, increasing water temperatures, and the appearance of new disease species, increasing water temperatures, and the appearance of new disease species, increasing water temperatures, and the appearance of new disease species, increasing water temperatures, and the appearance of new disease species, increasing water temperatures.
and decreased sea ice, all affect available species traditionally eaten by AN people, including potentially reducing harvesting success (42–49).

This study has significant strengths. It is the only longitudinal source of data on traditional food use and harvesting activities in this population, to our knowledge. Its maintenance of ascertainment methods provides confidence in the observed changes. These findings have important implications for AN health because traditional foods are nutrient dense and tend to be significantly healthier than alternative commercially available foods (7, 50). Intervention programs are needed that can promote diet quality and physical activity among AN people (51).

This study has several limitations. Only 29% of the original southcentral study participants completed the 10-y study follow-up. Follow-up study participants were of similar age but more likely to be female, educated, employed, and have a higher income than nonrespondents, which may be a threat to the internal validity of estimates derived from this study (52, 53). For example, people who are working may have less time to prepare traditional foods for consumption, or more disposable income to purchase foods or eat away from the home. In addition, only participants from the southcentral region were re-recruited for the follow-up cohort, so results reported here may not be generalizable to the entire Alaska EARTH study population, nor the AN population as a whole. In addition, data were collected by self-report, which is prone to previously noted random and systematic errors (54, 55). Finally, the current report does not include quantification of the amounts of traditional foods eaten.

In conclusion, traditional harvesting activities and foods in Alaska continue to be an important component of AN/AI food intake and physical activity, which speaks to the resilience of AN people. However, during the 10-y follow-up period the mean number and the variety of traditional foods consumed by participants declined. Promotion of and increased support for traditional food harvest and consumption may help maintain the health benefits associated with traditional food use and reduce the risk of chronic diseases among AN people.

Acknowledgments
We acknowledge the contributions and support of the Alaska Native Tribal Health Consortium Board of Directors and the Southcentral Foundation Board of Directors. The authors’ responsibilities were as follows—KRK and VYH: designed the research; VYH and JAB: conducted the research; GMD: analyzed the data and performed the statistical analysis; DGR and GMD: wrote the paper; SHN: contributed editorial content; DGR: had primary responsibility for the final content; and all authors: contributed additional comments and edits and read and approved the final manuscript. The authors report no conflicts of interest.

References
1. 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. Am J Diet Assoc 1995;95(6):676–82.
2. 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 2009;68(2):109–22.
3. Adler AI, Boyko EJ, Schraer CD, Murphy NJ. The negative association between traditional physical activities and the prevalence of glucose intolerance in Alaska Natives. Diabet Med 1996;13(6):555–60.
4. 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 2007;66(1):62–70.
5. 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 2008;108(2):266–73.
6. Kuhlenein HV, Receveur O, Chan HM. Traditional food systems research with Canadian Indigenous Peoples. Int J Circumpolar Health 2001;60(2):112–22.
7. Kuhlenein HV, Receveur O. Dietary change and traditional food systems of indigenous peoples. Ann Rev Nutr 1996;16:417–42.
8. Alaska Native Epidemiology Center. Final report on the Alaska Traditional Diet Survey. Anchorage, AK: Alaska Native Epidemiology Center, Alaska Native Health Board; 2004.
9. Snodgrass JJ, Leonard WR, Tarskaia LA, Schoeller DA. Total energy expenditure in the Yukut (Sakha) of Siberia as measured by the doubly labeled water method. Am J Clin Nutr 2006;84(4):798–806.
10. Lemas DJ, Klimentidis YC, Aslibekyan S, Wiener HW, O’Brien DM, Hopkins SE, Stanhope KL, Havel PJ, Allison DB, Fernandez JR, et al. Polymorphisms in stearoyl coa desaturase and steroid regulatory element binding protein interact with N-3 polyunsaturated fatty acid intake to modify associations with anthropometric variables and metabolic phenotypes in Yup’ik people. Mol Nutr Food Res 2016;60(12):2642–53.
11. Nobmann ED, Byers T, Lanier AP, Hankin JH, Jackson MY. The diet of Alaska Native adults: 1987–1988. Am J Clin Nutr 1992;55(5):1024–32.
12. Ballew C, Tzilkowski AR, Hamrick K, Nobmann E. The contribution of subsistence foods to the total diet of Alaska Natives in 13 rural communities. Ecol Food Nutr 2006;45(1):1–26.
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 2006;106(7):1055–63.
14. Johnson JS, Nobmann ED, Asay E. Factors related to fruit, vegetable and traditional food consumption which may affect health among Alaska Native People in Western Alaska. Int J Circumpolar Health 2012;71:17345.
15. Nobmann ED, Ponce R, Mattil C, Deveraux R, Dyke B, Ebbeson SO, Laston S, MacCluer J, Robbins D, Romenesko T, et al. Dietary intakes vary with age among Eskimo adults of Northwest Alaska in the GOCADAN study, 2000–2003. J Nutr 2005;135(4):856–62.
16. Murphy NJ, Schraer CD, Thiele MC, Boyko EJ, Bulkow LR, Doty BJ, Lanier AP. Hypertension in Alaska Natives: association with overweight, glucose intolerance, diet and mechanized activity. Ethn Health 1997;2(4):267–75.
17. O’Brien DM, Thummel KE, Bulkow LR, Wang Z, Corbin B, Klejka J, Hopkins SE, Boyer BB, Hennessey TW, Singleton R. Declines in traditional marine food intake and vitamin D levels from the 1960s to present in young Alaska Native women. Public Health Nutr 2017;20(10):1738–45.
18. Walch A, Loring P, Johnson R, Tholl M, Bersamin A. Traditional food practices, attitudes, and beliefs in urban Alaska Native women receiving WIC assistance. J Nutr Educ Behav 2019;51(3):318–25.
19. Hopkins SE, Austin MA, Metzger JS, Koller KR, Umans JG, Kaufmann C, Wolfe AW, Howard BV, Boyer BB. Sex differences in obesity prevalence and cardiometabolic factors among Western Alaska Native people. Nutr Metab Cardiovasc Dis 2015;25(3):312–18.
20. de Schweinitz PA, Wojcicki JM. First Nations approaches to childhood obesity: healthy lifestyles in Canada compared with alternatives for Alaska Native communities. Children 2017;4(5):38.
21. Murphy NJ, Schraer CD, Bulkow LR, Boyko EJ, Lanier AP. Diabetes mellitus in Alaskan Yup’ik Eskimos and Athabascan Indians after 25 yr. Diabetes Care 1992;15(10):1390–2.
22. Naylor JL, Schraer CD, Mayer AM, Lanier AP, Treat CA, Murphy NJ. Diabetes among Alaska Natives: a review. Int J Circumpolar Health 2003;62(4):363–87.
23. Carter EA, MacCluer JW, Dyke B, Howard BV, Devereux RB, Ebbesson SO, Resnick HE. Diabetes mellitus and impaired fasting glucose in Alaska Eskimos: the Genetics of Coronary Artery Disease in Alaska Natives (GOCAD) study. Diabetesologia 2006;49(1):29–35.

24. Koller KR, Metzger JS, Jolly SE, Umans JG, Hopkins SE, Kaufmann C, Wilson AS, Ebbesson SO, Raymer TW, Austin MA, et al. Cardiometabolic correlates of low type 2 diabetes incidence in western Alaska Native people – the WATCH study. Diabetes Res Clin Pract 2015;108(3):423–31.

25. Alaska Native Epidemiology Center, Alaska Native SEER Tumor Registry. Average annual age-adjusted cancer incidence rates per 100,000, Alaska Native and US White, 2009–2013. Anchorage, AK: Alaska Native Epidemiology Center; 2015.

26. White MC, Espey DK, Swan J, Wiggins CL, Eheman C, Kaur JS. Disparities in cancer mortality and incidence among American Indians and Alaska Natives in the United States. Am J Public Health 2014;104(Suppl 3):S377–87.

27. Jolly SE, Koller KR, Metzger JS, Day GM, Silverman A, Hopkins SE, Austin MA, Boden-Albala B, Ebbesson SO, Boyer BB, et al. Prevalence of hypertension and associated risk factors in Western Alaska Native People: the Western Alaska Tribal Collaborative for Health (WATCH) Study. J Clin Hypertens (Greenwich) 2015;17(10):812–18.

28. Vaughan LK, Wiener HW, Aslibekyan S, Allison DB, Havel PJ, Stanhope KL, O’Brien DM, Hopkins SE, Lemas DJ, Boyer BB, et al. Linkage and association analysis of obesity traits reveal novel loci and interactions with dietary n-3 fatty acids in an Alaska Native (Yup’ik) population. Metabolism 2015;64(6):689–97.

29. Redwood DG, Ferucci ED, Schumacher MC, Johnson JS, Lanier AP, Helzer LJ, Tom-Orme L, Murtaugh MA, Slattery ML. Traditional foods and physical activity patterns and associations with cultural factors in a diverse Alaska Native population. Int J Circumpolar Health 2008;67(4):335–48.

30. Slattery ML, Schumacher MC, Lanier AP, Edwards S, Edwards R, Murtaugh M, Sandidge J, Day GE, Kaufman D, Kanekar S, et al. A prospective cohort of American Indian and Alaska Native people: study design, methods, and implementation. Am J Epidemiol 2007;166(5):606–15.

31. Murtaugh MA, Ma KN, Greene T, Redwood D, Edwards S, Johnson J, Tom-Orme L, Lanier AP, Henderson JA, Slattery ML. Validation of a dietary history questionnaire for American Indian and Alaska Native people. Ethn Dis 2010;20(4):429–36.

32. 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: use for implementation of American Indian and Alaskan Native people. J Am Diet Assoc 2008;108(1):101–9.

33. Redwood D, Schumacher MC, Lanier AP, Ferucci ED, Ayas E, Helzer LJ, Tom-Orme L, Edwards SL, Murtaugh MA, Slattery ML. Physical activity patterns of American Indian and Alaska Native people living in Alaska and the southwestern United States. Am J Health Promot 2009;23(6):388–95.

34. Alaska Native Tribal Health Consortium, Alaska Native Epidemiology Center. [Internet] User Population. Available from: http://anthctoday.org/epicenter/healthData/factsheets/User_Population_Statewide_08_21_2018.pdf. Accessed: October 23, 2019.

35. Beans JA, Hiratsuka VY, Shane AL, Day GE, Redwood DG, Flanagan CA, Wilson AS, Howard BV, Umans JG, Koller KR. Follow-up study methods for a longitudinal cohort of Alaska Native and American Indian people living within urban south central Alaska: the EARTH study. J Community Health 2019;44(5):903–11.

36. Edwards SL, Slattery ML, Murtaugh MA, Edwards RL, Bryner J, Pearson M, Rogers A, Edwards AM, Tom-Orme L. Development and use of touch-screen audio computer-assisted self-interviewing in a study of American Indians. Am J Epidemiol 2007;165(11):1336–42.

37. Bild DE, Detrano R, Peterson D, Guerci A, Liu K, Shahar E, Ouyang P, Jackson S, Saad MF. Ethnic differences in coronary calcification: the Multi-Ethnic Study of Atherosclerosis (MESA). Circulation 2005;111(10):1313–20.

38. Taylor HL, Jacobs DR Jr, Schucker B, Knudsen J, Leon AS, Debacker G. A questionnaire for the assessment of leisure time physical activities. J Chronic Dis 1978;31(12):741–55.

39. Brooks-Cleator LA, Lewis JP. Alaska Native elders’ perspectives on physical activity and successful aging. Can J Aging 2019;1–11. DOI: 10.1017/S0714980819000400.

40. Walch A, Loring P, Johnson R, Tholl M, Bersamin A. A scoping review of traditional food security in Alaska. Int J Circumpolar Health 2018;77(1):1419678.

41. Fall J. Regional patterns of fish and wildlife harvests in contemporary Alaska. Arctic 2016;69(1):47–64.

42. Callaway D, Earner J, Edwardsen E, Jack C, Marcy S, Olrun A, Patkotak M, Rexford D, Whiting A. Effects of climate change on subsistence communities in Alaska. In: Weller G Anderson PA, editors. Assessing the consequences of climate change for Alaska and the Bering Sea Region. Fairbanks, AK: Center for Global Change and Arctic System Research, University of Alaska Fairbanks; 1998. p. 59–74.

43. Nuttall M, Berkes F, Forbes B, Kofinas G, Vlassova T, Wenzel H, Hunting, herding, fishing, and gathering: Indigenous peoples and renewable resource use in the Arctic. In: Symon C, Arris L. Heal B, editors. Arctic Climate Impact Assessment scientific report. Cambridge: Cambridge University Press; 2005. p. 649–90.

44. Fast H, Berkes F. Climate change, northern subsistence and land based economies. In: Mayer N Avis W, editors. Canada country study: climate impacts and adaptation. Ottawa: Environment Canada; 1998. p. 206–26.

45. Brubaker M, Berner J, Chavan R, Warren J. Climate change and health effects in Northwest Alaska. Glob Health Action 2011;4:8445.

46. Yoder S. Assessment of the potential health impacts of climate change in Alaska. State of Alaska Epidemiology Bulletin Recommendations and Reports. Anchorage, AK: State of Alaska Department of Health and Social Services; 2018.

47. Lynn KD, John D, Hoffman J, Lake F, Michelle N, Ranbo D, Viles C, Vogesser G, Williams P. The impacts of climate change on tribal traditional foods. Clim Change 2013;120(3):545–56.

48. Brubaker MY, Bell JN, Berner JE, Warren JA. Climate change health assessment: a novel approach for Alaska Native communities. Int J Circumpolar Health 2011;70(3):266–73.

49. Hupp J, Brubaker M, Wilkinson K, Williamson J. How are your berries? Perspectives of Alaska’s environmental managers on trends in wild berry abundance. Int J Circumpolar Health 2015;74:28704.

50. Egelman GM, Feyk LA, Middagh JP. Use of traditional foods in a healthy diet in Alaska: risks in perspective. Anchorage, AK: Section of Epidemiology, Alaska Division of Public Health, Department of Health and Social Services, State of Alaska; 1998.

51. Prochaska JJ, Epperson A, Skan J, Oppezzo M, Barnett P, Delucchi K, Schnellbaecher M, Benowitz NL. The Healing and Empowering Alaskan Lives Toward Healthy-Hearts (HEALTHH) Project: study protocol for a randomized controlled trial of an intervention for tobacco use and other cardiovascular risk behaviors for Alaska Native people. Contemp Clin Trials 2018;71:40–6.

52. Howe CJ, Cole SR, Lau B, Napravnik S, Eron JJ Jr. Selection bias due to loss to follow up in cohort studies. Epidemiology 2016;27(1):91–7.

53. Kristman V, Manno M, Côté P. Losstofollow-upincohortstudies:how muchistoomuch?EurJEpidemiol2004;19(8):751–60.

54. Rosenman R, Tennekoon V, Hill LG. Measuring bias in self-reported data. Int J Behav Healthc Res 2011;2(4):320–32.

55. Gehrig TL, Bronner-Lubben E, Jordan-Sweet C, Green S, Wilson K, Masse L. DiabetesmellitusandimpairedfastingglucoseinAlaskaNatives. CurrDevNutr 2019;3:1–11. DOI: 10.1017/S0714980819000400.

56. Nordman M, Petterson T, Nyberg S, Ljungberg M, Nordin BEC, Willman A, et al. The effect of smoking and other lifestyle factors on the risk of type 2 diabetes: a familial aggregation study. Diabetologia 2001;44(5):699–704.

57. Bhandari N, Neufeld KZ, Jones LA, Lin TR, Zhang S, et al. Multi-Ethnic Study of Atherosclerosis (MESA). Circulation 2008;118(23):2340–50.

58. Bild DE, Detrano R, Peterson D, Guerci A, Liu K, Shahar E, Ouyang P, Jackson S, Saad MF. Ethnic differences in coronary calcification: the Multi-Ethnic Study of Atherosclerosis (MESA). Circulation 2005;111(10):1313–20.

59. Taylor HL, Jacobs DR Jr, Schucker B, Knudsen J, Leon AS, Debacker G. A questionnaire for the assessment of leisure time physical activities. J Chronic Dis 1978;31(12):741–55.

60. Brooks-Cleator LA, Lewis JP. Alaska Native elders’ perspectives on physical activity and successful aging. Can J Aging 2019;1–11. DOI: 10.1017/S0714980819000400.

61. Walch A, Loring P, Johnson R, Tholl M, Bersamin A. A scoping review of traditional food security in Alaska. Int J Circumpolar Health 2018;77(1):1419678.

62. Fall J. Regional patterns of fish and wildlife harvests in contemporary Alaska. Arctic 2016;69(1):47–64.