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Obesity Prevalence and Dietary Factors Among Preschool-Aged Head Start Children in Remote Alaska Native Communities: Baseline Data from the "*Got Neqpiaq?*" Study

Courtney M. Hill, MS,[1,2] Mallie J. Paschall, PhD,[3] Kathryn R. Koller, PhD,[4]
Gretchen M. Day, MPH,[4] Flora R. Lee, BSN,[4] Diane M. O'Brien, PhD,[1] Diane K. King, PhD,[5]
Lea Palmer, MPH, RDN, LD,[6] Timothy K. Thomas, MD,[4] and Andrea Bersamin, PhD[1]

Abstract

Background: American Indian and Alaska Native preschool-aged children experience a high prevalence of obesity, yet are underrepresented in obesity prevention research. This study examined obesity prevalence and dietary risk factors among Alaska Native preschool-aged children in southwest Alaska.

Methods: The study used baseline data from "*Got Neqpiaq?*" a culturally centered multilevel intervention focused on Yup'ik Alaska Native children, aged 3–5 years, enrolled in Head Start in 12 communities in southwest Alaska ($n = 155$). The primary outcomes were BMI percentile, overweight, and obesity. Dietary factors of interest were measured using biomarkers: traditional food intake (nitrogen stable isotope ratio biomarker), ultraprocessed food intake (carbon stable isotope ratio biomarker), and vegetable and fruit intake (skin carotenoid status biomarker measured by the Veggie Meter). Cardiometabolic markers (glycated hemoglobin [HbA1c] and blood cholesterol) were also measured.

Results: Among the Yup'ik preschool-aged children in the study, the median BMI percentile was 91, and the prevalence of overweight or obesity was 70%. The traditional food intake biomarker was negatively associated with BMI, whereas the ultraprocessed foods and vegetable and fruit biomarkers were not associated with BMI. HbA1c and blood cholesterol were within healthy levels.

Conclusions: The burden of overweight and obesity is high among Yup'ik preschool-aged children. Traditional food intake is inversely associated with BMI, which underscores the need for culturally grounded interventions that emphasize traditional values and knowledge to support the traditional food systems in Alaska Native communities in southwest Alaska. Registered with ClinicalTrials.gov #NCT03601299.

Keywords: Alaska Native; dietary intake; fruits and vegetables; obesity prevention; traditional foods; ultraprocessed foods

[1]Center for Alaska Native Health Research, University of Alaska Fairbanks, Fairbanks, AK, USA.
[2]Department of Epidemiology, University of Washington, Seattle, WA, USA.
[3]Prevention Research Center, Pacific Institute for Research and Evaluation, Berkeley, CA, USA.
[4]Research Services, Alaska Native Tribal Health Consortium, Anchorage, AK, USA.
[5]Center for Behavioral Health Research and Services, University of Alaska Anchorage, Anchorage, AK, USA.
[6]Head Start Program, Rural Alaska Community Action Program, Inc., Anchorage, AK, USA.

Introduction

American Indian and Alaska Native preschool-aged children are significantly more likely to have obesity than all other ethnic groups in the United States.[1,2] Of particular concern is that in remote Yup'ik Alaska Native communities in southwest Alaska, 51% of 3-year-old children have obesity.[3] Prevalence of obesity continues to grow in the United States,[4] and has reached epidemic proportions among children.[5]

Obesity prevalence among American Indian and Alaska Native populations is especially concerning, given disproportionately higher mortality rates from obesity-related chronic conditions compared with non-Indigenous populations in the United States.[6] For example, the prevalence of type 2 diabetes increased by as much as 309% between 1985 and 2006 among Alaska Native adults in southwest Alaska.[7] Despite these trends, Alaska Native children are seriously under-represented in obesity prevention research.[8]

In Alaska Native communities, obesity is largely attributed to colonization and a concomitant shift in dietary patterns away from reliance on traditional foods such as fish, marine mammals, game, birds, berries, and greens. The health of Alaska Native people is inextricably linked to their traditional, subsistence food system. For Indigenous communities, traditional foods bolster diet quality,[9,10] and promote spiritual, mental, emotional, and physical health.[11] Consuming higher amounts of traditional Alaska Native foods is associated with higher intake of multiple nutrients, including more vitamin A, vitamin D, vitamin E, iron, and n-3 fatty acids.[9,10]

Climatic and socioeconomic pressures over the past several decades have also compromised the traditional food system, and consumption of traditional foods has declined.[12] In turn, the consumption of shelf-stable ultraprocessed foods from stores, which contain high levels of sugar, saturated fat, and sodium, has increased. Intake of ultraprocessed foods tends to be associated with higher risk of a number of chronic diseases, including obesity.[13] Alaska Native youth (14–18 year olds) consume significantly less traditional foods than older age groups,[9,12,14] placing them at elevated risk of developing chronic diseases as they enter higher risk age groups. It is unknown to what extent preschool-aged Alaska Native children consume traditional foods and other foods connected to obesity risk.

In this study, we examined intake of traditional foods, ultraprocessed foods, and vegetables and fruits among Alaska Native children aged 3–5 years enrolled in Head Start in 12 remote Alaska Native communities in southwest Alaska. We selected these dietary factors because of their links to obesity and because they are of public health importance in many Alaska Native communities. We also investigated the association between these dietary factors and BMI.

This article builds on previous research in three important ways. First, it provides consistently measured heights and weights of Alaska Native children aged 3–5 years. Previous studies have relied on self-reported data collected through surveillance efforts, which can introduce bias. Second, our study focuses on preschool-aged children, which extends our understanding of traditional food intake to a new age group because previous studies in remote Alaska Native communities have focused on populations aged >14 years. Finally, we use objective measures of diet and cardiometabolic biomarkers, which have advantages relative to self-reported dietary measures that are subject to self-report bias.

Materials and Methods

This study presents baseline data from a cluster-randomized trial that was designed to test the effectiveness of a culturally centered multilevel intervention, "*Got Neqpiaq?*," on the prevalence of overweight and obesity among children aged 3–5 years enrolled in Head Start programs in 12 remote Yup'ik and Cup'ik communities in southwestern Alaska. Study data also included dietary biomarkers for intake of traditional foods, ultraprocessed foods, and vegetables and fruits. All study procedures were approved by the Alaska Area IRB (AAIRB), the Alaska Native Tribal Health Consortium (ANTHC) Board of Directors, and the Yukon Kuskokwim Health Corporation (YKHC) Human Studies Committee. University of Alaska Fairbanks ceded IRB approval to the AAIRB. The study was completed in accordance with the Declaration of Helsinki as revised in 2013.

Study Population and Setting

The study took place in 12 rural, remote communities in the Yukon–Kuskokwim region of southwest Alaska. The Yukon–Kuskokwim region is roughly the size of Oregon, and is considered the homeland of Yup'ik and Cup'ik people, two related Alaska Native ethnic groups. More than 24,000 Alaska Native people live across 58 communities in the region, and ~80% are of Yup'ik ethnicity. Communities practice a mixed economy, where families are reliant on varying levels of subsistence lifestyle practices (*i.e.*, hunting, fishing, and gathering) and cash incomes. All communities are located off the road system; communities can only be reached by small plane year-round, or by boat in the summer and snow machine in the winter.

All parents of children enrolled in Head Start in the 12 communities were invited to participate in the study through flyers sent home by Head Start staff and by word of mouth. Study communities ranged in size from <300 residents to just >1000. Across the 12 study communities, ~239 children aged 3–5 years were enrolled in Head Start programs and eligible to participate each year; classroom sizes ranged from 14 to 20 students, with two of the larger communities operating two separate classes each.

Participatory Research and Ethics

This study represents a partnership between an academic institution (University of Alaska Fairbanks), two Alaska Native tribal health organizations (ANTHC and YKHC), and a private, statewide, nonprofit organization (Rural Alaska Community Action Program, Inc. [or RurAL CAP]). The research team met with the Tribal Councils in each of the 12 study communities to share the goals of the study, answer any questions, and obtain approval to conduct the study. Local staff from Head Start helped explain the study to parents and facilitated data collection. Parents and Head Start staff in the communities also participated in naming the project ''*Got Neqpiaq?*'' which, in the Yup'ik language, loosely translates to ''Got Real Food?'' in reference to traditional Alaska Native foods.

Study Measures

Dietary biomarkers were collected at the time of weight measurement to ensure that weight data were compared with recent diet (*e.g.*, dietary biomarkers reflect diet in the past 4–8 weeks).

Body mass index. Child heights and weights were collected by study staff trained to follow a protocol based on the National Health and Nutrition Examination Survey III (NHANES III) Anthropometric Procedures Manual. Height was measured twice using a standing stadiometer and recorded to the nearest 1/8th inch. If measurements did not agree within 1/8th inch, height was measured a third time. Weight was measured on a Hopkins® EZ Carry 440LB Digital Scale (Hopkins Medical Products, Grand Rapids, MI) set to measure in pounds and tenths of pounds. The closest two of three measurements were averaged and recorded. Children were measured and weighed without shoes/boots or outerwear. The study biostatistician calculated BMI as weight (kg)/height (m^2), and adjusted for the child's sex and age using the US CDC 2000 reference data for ages 2 to <20 years to generate BMI-for-age percentiles.

Traditional and ultraprocessed food intake. Hair stable isotope ratios were used as objective biomarkers for dietary intakes of traditional foods (the nitrogen isotope ratio [NIR]) and ultraprocessed foods (the carbon isotope ratio [CIR]). These biomarkers have been previously validated against four 24-hour food recalls collected over one month in Yup'ik populations,[15–17] and successfully applied as dietary biomarkers in other studies with Yup'ik children and adults.[12,18,19] Validation studies have involved isotopic measurements in both hair and blood, which are highly correlated.[20,21] NIR and CIR values are presented in standard delta values as $\delta X = (R_{sample} - R_{standard})/(R_{standard}) \cdot 1000‰$, where X is the heavy isotope (^{15}N or ^{13}C), R is the ratio of heavy to light isotope ($^{15}N/^{14}N$ or $^{13}C/^{12}C$), and the standards are atmospheric N for nitrogen and Vienna PeeDee Belemnite for carbon.

The traditional food intake biomarker NIR is elevated in marine mammals and fish, which comprise most of the energy from traditional foods in the Yup'ik diet.[10] In a validation study, hair NIR values ranged from 6.9‰ to 15.2‰, and corresponded to diets where the percentage of energy from marine mammals and fish ranged from 0 to 57.[17]

The ultraprocessed food biomarker CIR is elevated in sweets, sugar-sweetened beverages, and store-purchased meats,[15,16] which contribute to a ''processed food'' dietary pattern that was described previously.[14]

For each isotopic biomarker, the hair sample was collected by cutting a small pinch of hair (~50 hairs) from the back of the head as close to the scalp as possible. The 1 cm section of hair proximal to the head was analyzed, which represents the last 4–8 weeks of intake. Samples were cleaned and prepared for stable isotope analysis as described elsewhere.[20] Analysis was completed at the Alaska Stable Isotope Facility using continuous-flow isotope ratio mass spectroscopy with a Costech ECS4010 Elemental Analyzer (Costech Scientific) interfaced to a Finnigan Delta Plus XP isotope ratio mass spectrometer through the Conflo III interface (Thermo-Finnigan).

Vegetable and fruit intake. Relative levels of vegetable and fruit intake were assessed using the Veggie Meter (Longevity Link Corp., Salt Lake City, UT), which measures skin carotenoid status and has been previously used in Yup'ik communities.[19] Following the protocol described by Ermakov et al,[22] participants were instructed to place their forefinger against the lens surface of the Veggie Meter with the help of a spring-loaded cover. Three readings were collected for each participant, and the glass lens of the Veggie Meter was cleaned with an optical cloth between each reading. Mean skin carotenoid status was calculated for each participant by averaging the three measurements. Skin carotenoid status is a unit-less value that ranges from 0 to 800 and represents intake from approximately the past 8 weeks.[23]

A validation study found that across a year of measurements, self-reported vegetable and fruit intake was correlated with skin carotenoid status measured by reflection spectroscopy ($r = 0.37$, $p < 0.001$).[24,25] The same study found a high correlation between reflection spectroscopy and resonance Raman spectroscopy ($r = 0.86$, $p < 0.001$), and between reflection spectroscopy and plasma carotenoids ($r = 0.70$, $p < 0.001$).

Glycated hemoglobin (HbA1c) and blood cholesterol. Both HbA1c and blood cholesterol are cardiometabolic correlates identified as predictors of metabolic syndrome in Alaska Native populations,[26] and other obesity-related, chronic conditions. We obtained both HbA1c and blood cholesterol levels in a nonfasting state, using a single finger stick blood sample. We conducted point-of-care (POC) testing with HbA1c Now® kits and battery-operated CardioChek® cholesterol analyzers (Polymer Technology Systems, Inc., Indianapolis, IN). HbA1c testing required 5 μL of whole blood, and was collected and analyzed first. If sufficient blood volume could be obtained after the HbA1c test, study staff collected another 15 μL for POC cholesterol testing.

All study team members conducting finger stick POC tests were trained and evaluated by research registered nurses before visiting the communities. Per protocol, parents were notified and advised if their child's blood levels were abnormal based on current America Diabetes Association criteria for prediabetes (HbA1c ≥5.7%)[27] or for hypercholesterolemia in adults aged ≥20 years (cholesterol level ≥200 mg/dL).[28] Study staff also notified the YKHC Research team of any abnormalities, which were then relayed to the community's YKHC-assigned primary medical provider for follow-up.

Additional measures. To measure child, parent, and household characteristics, primary caregivers completed a questionnaire. Child characteristics included age and sex. Parent characteristics included self-reported ethnicity, cultural identity (Yup'ik way of living and Kass'aq [white] way of living), and education level. Household characteristics included household income and food assistance use (Supplemental Nutrition Assistance Program [SNAP] and Special Supplemental Nutrition Program for Women, Infants, and Children [WIC]).

Statistical Analysis

Descriptive statistics for study variables were calculated using means and standard deviations (SD) or interquartile ranges (IQRs). Multivariable linear regression was used to examine associations between dietary factors and BMI percentile adjusting for demographic characteristics and cultural identity variables. Only observations with complete data for all variables were included in the multivariable model. All statistical analysis was completed using SPSS version 27 software (IBM SPSS Software, version 27; IBM. 2022, New York).

Results

Descriptive Statistics

A total of 155 children aged 3–5 years who were enrolled in Head Start participated in the study; this represented 61% of eligible children in the 12 partner communities. Children were, on average, 4 years old (range: 2.6, 5.1), and slightly less than half (47%) were female (Table 1). The majority of parents self-identified as Yup'ik ethnicity (82%) or Cup'ik ethnicity (13%), and 98.5% reported following a Yup'ik way of life ''some'' or ''a lot.'' A minority of parents (18%) did not complete high school, 49% completed high school, and 19% had some college-level education. About 50% of parents reported an annual household income of <$10,000 and ∼26% reported an annual household income between $10,000 and $50,000. More than 80% of parents reported that they received public assistance for food through SNAP or WIC.

BMI Percentile and Prevalence of Overweight and Obesity

Overall, the median BMI percentile was 91.5 (91.3 for male children, 92.4 for female children) (Table 2). According to CDC criteria, the prevalence of overweight was 34.9%, and the prevalence of obesity was 35.5%. Prevalences of overweight and obesity were similar by child sex.

Table 1. Child, Parent, and Household Characteristics of 155 Yup'ik Alaska Native Children Aged 3–5 Years Enrolled in Head Start Who Participated in the "*Got Neqpiaq?*" Study in Southwest Alaska

Child, parent, and household characteristics	Yup'ik children aged 3–5 years enrolled in Head Start ($N = 155$) mean (SD), range or n (%)[a]
Child age (years)	4.02 (0.62), 2.58–5.06
Child sex	
Male	82 (52.9%)
Female	73 (47.1%)
Parent ethnicity	
Yup'ik	122 (82.4%)
Cup'ik	19 (12.8%)
Athabascan	2
Inupiaq	2
Other	3
Missing	7
Parent cultural identity	
Follows Yup'ik way of life	
A lot	62 (44.6%)
Some	75 (53.9%)
Not at all	2
Missing	16
Follows Kass'aq (white) way of life	
A lot	45 (32.8%)
Some	83 (59.7%)
Not at all	9 (6.5%)
Missing	18
Parent education	
Did not complete high school	28 (18.1%)
Completed high school	76 (49.0%)
Some college	30 (19.4%)
Graduated from college	2
Missing	19
Annual household income	
<$10,000	69 (49.6%)
$10,000–$14,999	12 (8.6%)
$15,000–$24,999	8 (5.8%)
$25,000–$34,999	7 (5.0%)
$35,000–$49,999	8 (5.8%)

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Table 1. Child, Parent, and Household Characteristics of 155 Yup'ik Alaska Native Children Aged 3–5 Years Enrolled in Head Start Who Participated in the "*Got Neqpiaq?*" Study in Southwest Alaska *continued*

Child, parent, and household characteristics	Yup'ik children aged 3–5 years enrolled in Head Start (*N* = 155) mean (SD), range or *n* (%)[a]
$50,000–$74,999	8 (5.8%)
$75,000–$99,999	2
>$99,999	1
Not sure	24 (17.3%)
Missing	16
Food assistance participation	
SNAP benefits or Quest card	118 (84.3%)
WIC	112 (80.0%)
Missing	15

[a]Missing data were excluded from the % calculation.

SD, standard deviation; SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

Dietary Factors

Detailed findings related to dietary factors are presented in Table 3. In brief, the mean NIR ($\delta^{15}N$ value) was 8.8‰, and the mean CIR ($\delta^{13}C$ value) was −17.0‰. Mean skin carotenoid status was 195.5 for the overall sample; 189.3 for male children and 202.6 for female children. Mean hemoglobin HbA1c levels were 5.1% for the total sample. The mean level of total cholesterol was 144.3 mg/dL for the total sample.

Associations Between Dietary Factors and BMI

When controlling for all other study variables, the traditional food intake biomarker was significantly associated with BMI percentile, where lower intake of traditional foods was associated with a higher BMI percentile Table 4. Total cholesterol level was positively associated with BMI percentile, although this relationship was not statistically significant. Biomarker measures for other dietary factors were not associated with BMI percentile when controlling for other study variables.

Discussion

Consistent with previous studies among Indigenous children in the United States and Canada, our findings show that the prevalence of overweight or obesity among preschool-aged Yup'ik Alaska Native children is high, and may even be higher than previous estimates in Yup'ik communities based on surveillance.[3,29] Findings show that 70% of participants in the study were classified as having overweight or obesity status, which highlights the urgent need for effective obesity prevention efforts. A key finding of this study was that traditional food intake was inversely related to BMI, which further highlights the importance of developing culturally grounded interventions rooted in traditional values and knowledge, as well as supporting traditional food systems.

Early childhood marks a critical time to intervene by introducing nutritious traditional subsistence foods to prevent obesity and its negative sequela. Among the preschool-aged children in the study, HbA1c and cholesterol levels remained within healthy levels despite high levels of obesity, which conflicts with research among children in the United States that suggests that obesity is associated with increased cardiometabolic risk factors.[30]

Although the literature of the impact of traditional foods on weight status is mixed,[31,32] dietary patterns high in traditional foods tend to be lower in ultraprocessed foods.[33] Furthermore, intake of traditional foods is considered an

Table 2. BMI Percentile and Prevalence of Overweight and Obesity for 152 Alaska Native Yup'ik Children Aged 3–5 Years Enrolled in Head Start Who Participated in the "*Got Neqpiaq?*" Study in Southwest Alaska

	Male children (*n* = 80)	Female children (*n* = 72)	All children (*N* = 152)
BMI percentile,[a] median (IQR)	91.3 (20.4)	92.4 (13.1)	91.5 (14.2)
Underweight, *n* (%)	0	0	0
Healthy weight, *n* (%)	25 (31.3%)	20 (27.8%)	45 (29.6%)
Overweight, *n* (%)	27 (33.8%)	26 (36.1%)	53 (34.9%)
Obese, *n* (%)	28 (35.0%)	26 (36.1%)	54 (35.5%)

[a]BMI was calculated as weight (kg)/height $(m)^2$, and adjusted for the child's sex and age using the United States Centers for Disease Control and Prevention 2000 reference data for ages 2 to <20 years to generate BMI-for-age percentiles.

IQR, interquartile range.

Table 3. Dietary Biomarkers of Traditional Foods, Ultraprocessed Foods, and Vegetable and Fruit Intake for Yup'ik Alaska Native Children Aged 3–5 Years Enrolled in Head Start Who Participated in the "*Got Neqpiaq*?" Study in Southwest Alaska

	Male children mean (SD)	Female children mean (SD)	All children mean (SD)
Traditional food intake	$n=75$	$n=68$	$n=143$
NIR,[a] ‰	8.64 (0.80)	8.94 (0.83)	8.78 (0.82)
Ultraprocessed food intake	$n=75$	$n=68$	$n=143$
CIR,[b] ‰	−16.96 (0.75)	−17.08 (0.72)	−17.02 (0.73)
Vegetable and fruit intake	$n=77$	$n=67$	$n=144$
Skin carotenoid status[c]	189.3 (83.8)	202.6 (103.0)	195.5 (93.1)
Blood sugar	$N=57$	$N=47$	$n=104$
Hemoglobin HbA1c, %	5.10 (0.24)	5.06 (0.27)	5.08 (0.25)
Cholesterol	$n=47$	$n=34$	$n=81$
Total cholesterol, mg/dL	143.2 (20.2)	145.7 (21.4)	144.3 (20.6)

[a]Traditional food intake was measured using the NIR, expressed as permil (‰) relative abundance of heavy isotope [$\delta^{15}N = (^{15}N/^{14}N_{sample} - {}^{15}N/^{14}N_{std})/(^{15}N/^{14}N_{std}) \cdot 1000‰$], where the standard is atmospheric nitrogen. In a validation study, hair NIR values ranged from 6.9‰ to 15.2‰, and corresponded to diets where the percentage of energy from marine mammals and fish ranged from 0 to 57.

[b]Ultraprocessed food intake was measured using the CIR, expressed as permil (‰) relative abundance of heavy isotope [$\delta^{13}C = (^{13}C/^{12}C_{sample} - {}^{13}C/^{12}C_{std})/(^{13}C/^{12}C_{std}) \cdot 1000‰$], where the standard is Vienna Pee Dee Belemnite.

[c]Vegetable and fruit intake was evaluated as skin carotenoid status, which was measured using the Veggie Meter. Skin carotenoid status is a unitless measure that ranges from 0 to 800, and represents intake from approximately the past 8 weeks.

CIR, carbon stable isotope ratio; NIR, nitrogen stable isotope ratio.

important dimension of cultural connectivity, and cultural connectivity has consistently been related to lower weight status,[34] higher levels of physical activity,[35,36] and other components of well-being. This study measured intake of traditional foods using a validated biomarker that primarily captures marine mammal and fish intake,[17] the most commonly consumed traditional foods.[10]

While preschool-aged Yup'ik children in the study consumed higher levels of fish than their nationally representative counterparts, intake was comparable with Yup'ik adolescents, which is substantially lower than the intake among Yup'ik adults.[37] The observation that traditional food intake is greater among older age groups[9,12,14] highlights the need for early childhood interventions—both home and school based—that promote traditional food intake. In addition, continued reinforcement as children age may be needed to maintain healthier eating habits.

The stable isotope biomarker that was used to measure ultraprocessed food intake in this study suggested that ultraprocessed food intake was consumed at high levels among the Yup'ik preschool-aged children in this study. Findings from a study that used this biomarker to measure ultraprocessed food intake among Yup'ik adolescents found slightly lower CIR values and reported high intake levels of ultraprocessed foods, such as sugar-sweetened beverages.[18]

Compared with the findings of that study, intake levels of ultraprocessed foods among the preschool-aged children in this study may also exceed recommendations. Dietary assessments of other Indigenous populations, such as First Nations adults in Canada, have reported that intake of ultraprocessed foods constitutes ∼50% of energy,[38,39] and is inversely related to traditional food intake.[38] This finding underscores the importance of further research aimed at monitoring and reducing the intake of ultraprocessed foods in Alaska Native and other Indigenous communities.

A diet high in vegetables and fruit is recognized as the cornerstone of a healthy diet, and plays an important role in healthy growth.[40] Skin carotenoid status, as measured by the Veggie Meter, was not related to child weight status in this study. The lack of association could potentially be explained by the participants' uniformly low scores. The mean skin carotenoid status among Yup'ik preschoolers in this study was 195, which is lower than the mean reported among Yup'ik adults (mean score is 220)[19] and preschool-aged children in both California[41] and North Carolina[42] (mean score is 266 in both).

The low vegetable and fruit intake is not surprising when considering the food environment in remote Yup'ik communities. In these communities, store-purchased fresh vegetables and fruits are expensive and often unavailable,[43,44] and traditional practices of harvesting tundra plants have become less common in the past several decades. It is concerning that both traditional food intake and vegetable and fruit intake are lower among Yup'ik preschoolers than among older Yup'ik age groups as each contributes to a healthy diet.

Table 4. Association Between Dietary Biomarkers, Demographic Characteristics, and Parent Cultural Identity With BMI Percentile Among Yup'ik Alaska Native Children Aged 3–5 Years Enrolled in Head Start Who Participated in the "*Got Neqpiaq*?" Study in Southwest Alaska

Variable	β (SE)	Standardized β
Traditional food intake,[a] ‰	−6.99 (3.20)*	−0.34*
Ultraprocessed food intake,[b] ‰	−2.29 (3.24)	−0.10
Vegetable and fruit intake[c]	0.01 (0.02)	0.08
Hemoglobin HbA1c level, %	−8.45 (8.00)	−0.15
Total cholesterol level, mg/dL	0.21 (0.11)†	0.29†
Child age, years	−2.13 (3.32)	−0.09
Child sex (male)	4.37 (4.98)	0.15
Yup'ik ethnicity	0.16 (6.69)	0.004
Yup'ik cultural identity	0.79 (4.22)	0.029
Kass'aq cultural identity	−1.47 (3.96)	−0.06
Parent education level	−3.92 (3.00)	−0.19
Annual household income	−0.51 (1.53)	−0.06
SNAP participant	−5.97 (7.46)	−0.14
WIC participant	−2.00 (5.46)	−0.05

*$p < 0.05$, †$p = 0.06$; R^2 is 0.25. Multivariable linear regression.

[a]Traditional food intake was measured using the NIR, expressed as permil (‰) relative abundance of heavy isotope [$\delta^{15}N = (^{15}N/^{14}N_{sample} - {}^{15}N/^{14}N_{std})/(^{15}N/^{14}N_{std}) \cdot 1000‰$], where the standard is atmospheric nitrogen. In a validation study, hair NIR values ranged from 6.9‰ to 15.2‰, and corresponded to diets where the percentage of energy from marine mammals and fish ranged from 0 to 57.

[b]Ultraprocessed food intake was measured using the CIR, expressed as permil (‰) relative abundance of heavy isotope [$\delta^{13}C = (^{13}C/^{12}C_{sample} - {}^{13}C/^{12}C_{std})/(^{13}C/^{12}C_{std}) \cdot 1000‰$], where the standard is Vienna Pee Dee Belemnite.

[c]Vegetable and fruit intake was evaluated as skin carotenoid status, which was measured using the Veggie Meter. Skin carotenoid status is a unit-less measure that ranges from 0 to 800 and represents intake from approximately the past 8 weeks.

SE, standard error.

Limitations

Our results should be interpreted with the following limitations in mind. There is some uncertainty whether the cutoffs for overweight and obesity, derived from 2000 CDC growth reference data, are appropriate for Alaska Native children, given their stature. However, a recent study found that Canadian Inuit children have comparable stature with the CDC reference population, supporting use of the cutoffs.[45] Nonetheless, we present median and IQR for BMI percentiles to describe weight status in a way that is not tied to cutoffs.

As with most studies in Alaska Native communities, our sample size is small and may not be representative of the larger study population. In our 12 partner communities, however, 60% of eligible children participated, which represents a reasonable response rate and provides some certainty in our estimates. We did not collect data on reasons that parents did not enroll their child in the study. Anecdotally, the most common reasons were that parents were ''too busy,'' ''off moose hunting,'' or that the child was ill.

Conclusions

This study estimated the prevalence of overweight and obesity using a community-based sample of Yup'ik children aged 3–5 years enrolled in Head Start programs in 12 Alaska Native communities. It also examined the association of obesity-related dietary factors measured by biomarkers. The prevalence of overweight or obesity was 70%, and the traditional food intake biomarker was strongly negatively associated with BMI. Biomarkers for ultraprocessed food and vegetable and fruit intake were not associated with BMI.

Clearly, the development of obesity is complex and driven by factors beyond diet. Further research is warranted to explore additional risk factors of childhood obesity. Importantly, culturally grounded interventions in Alaska Native communities that center traditional values and knowledge are needed to support the traditional food systems.

Impact Statement

While Alaska Native children experience a disproportionate burden of overweight and obesity, obesity prevention research among Alaska Native children is limited. In this study, we measured the prevalence of overweight and obesity among Yup'ik preschoolers in remote southwest Alaska, and examined what dietary factors were associated with BMI.

Authors' Contributions

C.M.H. contributed to writing—original draft; writing—review and editing. M.J.P. performed formal analysis; writing—review and editing. K.R.K. contributed to conceptualization; funding acquisition; writing—review and editing. G.M.D. contributed to project administration; investigation; formal analysis; writing—review and editing. F.R.L. performed project administration; investigation; writing—review and editing. D.O'B., D.K., and T.K.T. contributed to conceptualization; writing—review and editing. L.P. carried out project administration; writing—review and editing. A.B. contributed to conceptualization; funding acquisition; writing—original draft; writing—review and editing.

Data Sharing

The data used in this study are not publicly available or accessible.

Disclaimer

Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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Author Disclosure Statement

No competing financial interests exist.

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Address correspondence to:
Andrea Bersamin, PhD
Center for Alaska Native Health Research
University of Alaska Fairbanks
PO Box 757000
Fairbanks, AK 99775
USA

E-mail: abersamin@alaska.edu