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Sociodemographic and psychosocial factors associated with diet quality in 6 rural Native American communities

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Abstract

Objective: To identify psychosocial and household environmental factors related to diet quality among Native Americans (NA).

Design: Analysis of baseline data from a community-randomized obesity prevention trial.

Setting: Six rural NA communities in the Midwest and Southwestern U.S.

Participants: 580 tribal members, 18–75 years old (mean 45 years), 74% female, self-identified as the main household food purchaser.

Variables Measured: Diet quality (Healthy Eating Index, HEI-2015) was derived from a semi-quantitative food frequency questionnaire. Sociodemographic, psychosocial, and home food environment factors were assessed via interviewer-administered questionnaires.

Analysis: One-way ANOVA, linear regression models, and two-tailed t-tests compared HEI scores among sociodemographic categories. Multiple linear regression models assessed the relation between psychosocial factors, home food environment and HEI.

Results: Prevalence of obesity was 59%. Mean HEI-2015 score was 49.3 (SD±8.1). Average HEI scores were 3.0 points lower in smokers than non-smokers ($p<0.001$), and 2.2 points higher in females than males ($p<0.01$). Higher self-efficacy ($B=0.97$; $p<0.001$) and healthier eating intentions ($B=0.78$; $p<0.001$) were positively associated with HEI. Healthier household food patterns score was associated with higher HEI ($B=0.48$; $p<0.01$).

Conclusions and Implications: Psychosocial factors were associated with diet quality, a finding that supports the use of social-cognitive intervention approaches in rural NA communities

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in the Midwest and Southwest, and warrants evaluation in other locations. There remains a need to elucidate the association between FDPIR and diet quality.

Keywords

American Indians; Native Americans; Diet; Healthy Eating Index; Psychosocial factors

INTRODUCTION

Native Americans (NA) bear a disproportionately high burden of chronic disease compared to other races/ethnicities in the U.S.[1] While data on the diet quality of NA populations is scarce, previous studies that included NAs have found that diet quality is inadequate and tends to be lower than in other population groups.[2–4] It is widely accepted that the shift away from traditional diet and lifestyle patterns towards western consumption and physical activity patterns is a major factor in the upsurge of chronic diseases among NAs throughout the past century.[5] This shift is a direct result of the forcible removal of NAs from their tribal lands, as well as the removal of children from their families as part of the government effort to “re-educate” and “westernize” NAs. While there are over 500 federally-recognized tribes in the United States that represent widely varying cultural customs and genetic heritage, they share a common history of intergenerational trauma and displacement as a result of colonialism, which has led to high rates of poverty.[6,7]

Socioeconomic status is an important predictor of both nutrition knowledge and Healthy Eating Index (HEI) score.[8] However, there is some evidence that these relationships may vary widely by ethnicity. For instance, in an analysis of national data, the positive association between greater nutrition- and health-related knowledge and higher diet quality was stronger among non-Hispanic whites than in all other ethnicities.[9] Another study in a predominantly Hispanic population in the Southwestern U.S. suggested that there might be cultural influences on eating behaviors that could help explain null associations between nutrition knowledge and healthier eating patterns.[10] A study in NA youth corroborate these findings, as authors found that neither self-efficacy nor healthy eating intentions were positively correlated with healthy eating behavior, but food choice was significantly associated with subjective norms and barriers.[11]

Psychosocial factors, including nutrition knowledge, self-efficacy, and behavioral intentions are key determinants of diet and health.[12] According to the Social Cognitive Theory (SCT) model, there is reciprocal interaction between the environment, personal factors, and behavior, where individuals reflect on their own choices and capabilities of repeating behavior (self-efficacy) while being influenced by and shaping their environment[12]. There is a growing body of evidence to support interventions that target psychosocial factors in order to improve dietary habits and health outcomes,[13–15] To the authors’ knowledge however, no published studies to date have examined how psychosocial factors relate to overall diet quality in rural NA reservation communities, where complex barriers to healthy food consumption exist.[16–19] There is limited but encouraging evidence among rural-dwelling NA adults that individual psychosocial factors are related to healthier food selection and cooking methods,[20] which are key antecedents to food consumption. Several studies have assessed psychosocial factors and diet quality (or a partial proxy, such as fruit and vegetable consumption) in NA youth populations, with evidence of the relationship differing by age group.[21,22] Better understanding the association between psychosocial factors and diet quality among NA adults in rural reservation-based communities in the Midwest and Southwest can help focus future intervention development efforts on key aspects that are strongly related to diet quality.

This paper uses cross-sectional data to examine the individual and household sociodemographic and psychosocial factors associated with diet quality among NA adults in the Midwest and Southwestern United States. The aim in doing this was to assess the following research questions: 1) *Which sociodemographic characteristics are related to diet quality among rural-dwelling Native American adults in the Midwest and Southwest?* and 2) *How do psychosocial factors relate to diet quality in this study population?* It was hypothesized that household food patterns and personal psychosocial factors such as food knowledge, self-efficacy for healthy eating, and healthy food intentions would be positively associated with diet quality among NA adults, holding sociodemographic characteristics constant. Exploring these potential associations is an important step in determining the appropriateness of social cognitive intervention approaches in reservation-based communities in the Midwest and Southwest. It may also help identify specific sociodemographic subgroups that could benefit from targeted interventions.

METHODS

Research Design

The analyses presented here used baseline data from a multi-level multi-component (MLMC) community-randomized controlled trial aimed at decreasing and preventing obesity in NAs (OPREVENT2).[23] OPREVENT2 is an ongoing intervention implemented in 6 rural NA communities – 2 in the Midwest and 4 in the Southwest region of the U.S. The intervention was designed to address unique aspects of the community food environment present at multiple levels within the context of life in rural NA communities and on NA reservations, for example by promoting healthier foods in food stores, creating community action committees to address tribal policy, implementing a school curriculum to enable children to act as positive agents of change in their families, and community media messaging (eg. radio, newsletters, posters, social media). It draws from Bronfenbrenner's social ecological model, viewing the interplay between different levels of society as a system in which each level influences and can be influenced by others.[24] The intervention design also draws from SCT, through the assumption that individual knowledge and behaviors are influenced by the social interactions and environment within a community.[12]

Sampling

Baseline data were collected from individual adult tribal members (18–75 years old) in at least 100 randomly-selected households from each of the 6 communities. Each community was located on a reservation or tribal land, and 15–80 miles away from the nearest town with a large grocery store. In total, 601 adults were interviewed between August 2016 and April 2017. In 4 of the communities, the research team randomly selected households to contact from a complete master list of residents provided by local tribal authorities. Due to privacy concerns in 2 communities, the tribal authorities did not share a master list of residents but provided names of randomly-selected individuals after they agreed to participate. All potential participants were first contacted by telephone. After receiving approval from tribal leaders in each community, as well as written informed consent from individual participants, interviews were conducted with 1 adult per household who self-identified as the main food purchaser or preparer, was not currently pregnant, and had no plans to move for the next 2 years. Participants were invited to local community centers to complete the interviews which were conducted either in English or in the local native language upon request. Approximately 70% of the interviews were conducted in English, while 15% were conducted in the local tribal language, and another 15% were conducted in a mix of English and a tribal language. If an individual was unavailable or declined to participate, the next randomly-selected individual from the recruitment list was contacted. In total, 859 people were contacted, with a response rate of 70%. Twenty-four people declined the invitation to participate, and 234 were ineligible because they did not meet the study criteria. The most common reasons for ineligibility were not being 18–75 years of age, not the main food preparer/shopper, and no longer living in one of the study communities.

Measurement Instruments

Height and weight were measured[25] by data collectors using a portable Seca 213 Stadiometer (Seca GmbH & Co. KG) and Tanita 300GS digital scale (Tanita Corp). Dietary data were collected through a 118-item semi-quantitative Block Food Frequency Questionnaire (FFQ). Previous studies suggest that the Block FFQ is a valid measure of dietary intake in a variety of populations.[26–29] The FFQ was modified from one used in the Strong Heart Study of Cardiovascular Disease in American Indians (Phase V), which was validated in tribes from Oklahoma, Arizona, and North and South Dakota.[30] Modifications were based on information gathered during the extensive formative research phase, and included the addition of commonly-consumed foods such as *piñon nuts* in the Southwest and *deer meat(venison)* in the Midwest, as well as specific foods that were promoted or discouraged during the OPREVENT2 intervention. The FFQ was pilot tested in 2 NA communities in the Midwest and Southwest that did not participate in OPREVENT2. It was administered to 33 participants, who were then asked to provide feedback related to clarity of instructions, appropriateness of among and frequency options, and whether there were any foods or beverages that should be added or removed. Finding adequate overall acceptability, the modified FFQ was adapted for use in the study. Usual portion size and frequency of consumption of each food item over the past 30 days were probed, with possible responses including *never, once per month, 2–3 times per month, once per week, 2 times per week, 3–4 times per week, 5–6 times per week,* and *every day.* Psychosocial and demographic data were collected in a 151-item Adult Impact Questionnaire (AIQ), which was developed for use in a previous study in 2 NA communities,[20] and modified to reflect the unique characteristics of the current study communities during the extensive formative phase of the OPREVENT2 study.[23] Four questions about household-level behaviors were used to construct a household food patterns score. The psychosocial data come from 9 questions about nutrition knowledge, 10 questions about self-efficacy for healthy eating, and 8 questions about healthy eating intentions. All data collectors participated in a one-week training, led by the principal investigator and assisted by two senior doctoral students, prior to beginning the study. Data collectors were members of local tribes in their data-collection region and could speak the local tribal language. If participants became fatigued during the interview, they were offered a 15-minute break or the option to finish another day. Each participant received a $40 gift card upon full completion of the baseline survey interview.

Diet Quality

The completed Block FFQs were sent to NutritionQuest (Berkley, California) for processing and calculation of nutrient intakes. These results were used by the research team to calculate a Healthy Eating Index-2015 (HEI-2015) score for each participant. The HEI-2015 assesses adherence to the 2015–2020 Dietary Guidelines for Americans and is a valid and reliable measure of diet quality in the general U.S. population,[31] but has not been validated in NA populations. Nine food components were assessed for adequacy of intake, where higher scores indicate higher consumption: total fruit (0–5 points), whole fruit (0–5 points), total vegetables (0–5 points), greens and beans (0–5 points), whole grains (0–10 points), dairy (0–10 points), total protein foods (0–5 points), seafood and plant proteins (0–5 points), and fatty acid ratio (0–10 points). In addition, 4 food components were assessed for moderation in the diet where higher scores indicate lower consumption: refined grains (0–10 points), sodium (0–10 points), saturated fats (0–10 points), and added sugars (0–10 points). The total HEI-2015 score is the sum of each component score and is based on a continuous scale of 0–100 points, with 100 points being the maximum adherence to the DGA.

Four individual sub-components of the HEI-2015 scores were also used in the analysis, including saturated fat, refined grains, added sugars, and sodium. These components were selected for their well-established negative impacts on the most common chronic diseases among the NA groups in this study – hypertension, type II diabetes, obesity, and cardiovascular disease, which vary by region and tribe.[1,5,32]

Psychosocial Factors and Scale Construction

Nutrition knowledge was measured by 9 multiple-choice questions, which included 2 questions about dietary fiber, 2 questions about sugar, 2 questions about fat, and 3 questions about label reading. For example: *Which kind of bread has the most fiber? a) Fry bread; b) White bread; c) 100% whole wheat bread; d) Don't know.* Food knowledge scores were calculated by summing the number of correct responses for each participant. (Kuder-Richardson formula 20 value = 0.63)

Self-efficacy for healthy eating was measured by 10 questions that the respondent was asked to categorize as either easy or difficult, within the current context of their life circumstances (ie. affordability, family food preferences, etc.). For example, *"Would it be difficult or easy for you to choose water instead of regular soda?"* A response of "difficult" was scored as 0 points, and a response of "easy" was scored as 1 point. Higher self-efficacy for healthy eating scale indicated that the respondent had confidence in decision-making about healthy eating. (Cronbach's alpha = 0.63)

Healthy eating intentions were measured by 8 multiple-choice questions that were evaluated on a scale of 0–2 points, for example *"If you had to buy milk, which would you buy? a) Whole milk (0 points); b) 2% milk (1 point); c) Skim or 1% milk (2 points).* Higher healthy eating intention scale indicated that respondent had a positive inclination towards healthy eating. (Cronbach's alpha = 0.60)

Household Food Patterns

Four questions in the AIQ probed for the frequency of various household-level food behaviors, including 1) meal planning/using a shopping list; 2) eating meals with other household members; 3) bringing prepared restaurant foods home; and 4) preparing meals with other household members. Each question had 4 possible responses ranging from "Never" (0 points) to "Most of the time" (3 points). When calculating total household food pattern scores, the question about bringing home prepared restaurant foods was scored inversely ("Never"=3, "Most of the time"=0) to reflect its expected relationship with diet quality in the opposite direction compared to the other questions. (Kuder-Richardson formula 21 value = 0.54)

Sociodemographic Characteristics—The sociodemographic characteristics used in this analysis included individual characteristics such as age (stratified using median age value of 46 years old), sex, geographic region, educational level, employment status, BMI (calculated from data collector-measured height and weight according to WHO guidelines[33]), smoking status, and self-reported comorbidities, and household-level factors including household size, and participation in food assistance programs.

Statistical Analyses

Statistical analyses were carried out using IBM SPSS Statistics for Windows, version 25 (IBM Corp., 2017, Armonk, NY, USA). Prior to commencing analyses, data were checked for accuracy, outliers, and missing values. In the case of missing data and outliers, the data manager contacted the data collector who had conducted the interview for clarification. If necessary, the data collector then called the participant in order to collect the missing data. In line with a previous study that used FFQ in a NA population, participants reporting calorie intakes <500 kCal/day or >7,000 kCal/day[34] were excluded from analyses (21 cases), which brought the final sample size to 580. The sociodemographic characteristics of excluded cases did not differ significantly from the rest of the sample.

Descriptive statistics were evaluated for individual and sociodemographic characteristics of the sample. Two-tailed independent t-tests, one-way ANOVA, and multiple linear regression models were used to compare the total mean HEI-2015 score among sociodemographic factors. The model specification checks used here, including assessment of model residuals, revealed that treating total HEI-2015 in its continuous form was appropriate and did not violate linearity assumptions. Normality of the residuals was checked by combining the results of graphs and visuals such as the univariate kernel density estimation, q-q-plots, and the test of Shapiro-Wilk for normality, where normality was established if p>0.05. However, to correct for the non-normality of the selected HEI component sub-scores (i.e., saturated fat, refined grain, added sugars, and sodium) and to avoid multiple comparison issues, bootstrapped statistical analyses with 2000 iterations were used, and bias-adjusted 95% confidence intervals were examined to control the proportion of Type I errors.

Multiple linear regression models were used to assess the association between psychosocial factors, household food patterns and diet quality, separately. All models were adjusted for confounding variables and clustered by community (6 communities). For all analyses, statistical significance was defined by a p-value of <0.05, and the variance inflation factor was calculated for each model to check for collinearity, which were all below 1.0. Missing data were deleted listwise, and ranged from 0–13 missing (deleted) cases across the household and psychosocial constructs (see Tables 2 and 3 for n included in each model).

Ethical Approval—The research conducted in OPREVENT2 has been approved by the Institutional Review Boards at the Johns Hopkins Bloomberg School of Public Health, the National Indian Health Service (IHS) IRB, and the Navajo Nation Human Research Review Board (NNHRRB). As required by IHS, individual tribal council review and approval were sought before IHS approval. Importantly, tribal approvals were acquired from all potential participant communities before obtaining the grant that would fund the OPREVENT2 trial.

All potential conference abstracts and manuscripts for publication that contain data from this study are sent to each tribal council in the communities that participated. The PI must receive a signed letter of approval from each tribal council before these data can be presented at a conference or a manuscript can be published. An agreement was also formed with one tribe to provide them with the original (de-identified) data collected in their community once the study is over, for further analysis or disposal.

RESULTS

The prevalence of obesity in this study population was 59%. Approximately 74% of the participants were female, and the average age was 45 years. Overall, 28% reported being current smokers, but there were large differences in smoking by region. Nearly 58% of participants in the Midwest region reported being current smokers, compared to 13% in the Southwest.

The mean HEI score in this population was 49.3 (SD 8.1). For Nutrition Knowledge, possible scores ranged from 0 – 9 points, with a mean of 6.5 (SD 2.0). Possible self-efficacy scores ranged from 0 – 10, with a mean of 7.3 (SD 2.1). Healthy eating intentions scores had a possible range of 0 – 16, with a mean of 10.8 (SD 3.0). Possible scores for household food patterns ranged from 0 – 16, with a mean of 11.6 (SD 2.2).

Sociodemographic Factors Associated with Diet Quality

Sociodemographic factors associated with total HEI and moderation sub-component scores are shown in Table 1. Participants' HEI scores differed significantly by geographic location: those in the Southwest region of the U.S. had an average score 3.4 points higher than those in the Midwestern U.S. ($p<0.001$). Despite a lower total mean HEI than their Southwestern counterparts, Midwestern participants had better average refined grain sub-scores than those in the Southwest, while saturated fat and added sugar scores were significantly lower. These same trends in HEI sub-scores were observed when comparing smokers vs non-smokers. Receiving FDPIR food assistance was associated with lower saturated fat and sodium scores indicating higher intake, but refined grain and added sugar scores were not significantly different from those not receiving FDPIR. Participants who did not receive any food assistance had significantly higher (better) refined grain scores, but lower (worse) added sugar scores than those who reported participating in 1 or more food assistance programs.

Individual Psychosocial Factors Associated with Diet Quality

Associations between individual psychosocial factors (knowledge, self-efficacy, and intentions) and diet quality were examined using multiple linear regression models, adjusted for age (continuous), sex (reference female), education (continuous), smoking (reference non-smoker), and clustered by community (Table 2). For each additional point in mean healthy eating intentions and self-efficacy, there was an increase in almost 1 point in HEI total score, after holding covariates constant. Additionally, healthier eating intentions was associated with higher scores for saturated fat, indicating lower saturated fat intake for each additional point in intentions.

Household Food Patterns Associated with Diet Quality

In a multiple linear regression model, each additional point increase in healthier household-level food pattern was associated with an increase of nearly 0.5 HEI total points, after controlling for age, sex, education, smoking, and clustering by community. Sub-scores for meal planning or shopping with a list and preparing food with others were also positively associated with total HEI. However, eating meals with others and bringing home prepared restaurant foods were not related to diet quality in this population (Table 3).

DISCUSSION

To the authors' knowledge, this is the first study to examine the association between overall diet quality and psychosocial factors or household food patterns among NA adults. The mean HEI-2015 score in this population is 10 points below the mean score in the general U.S. population.[35] Previous studies in rural NA populations have also found that diet quality is lower than in other population subgroups.[2,4] However, the average refined grain score in this study sample was better than the average U.S. score (9.0 vs 6.2), and the sodium component scores were better as well (4.7 vs 4.0). The mean refined sugar component was notably worse among study participants than in the general U.S. population (3.4 vs 6.5), along with the saturated fat scores (4.2 vs 5.8). While some of these differences may be in part attributable to differences in data collection methodology (FFQ in this study vs 24-hour recalls), the low added sugar and saturated fat scores in this study warrant further investigation given the well-established associations between consumption of added sugars and type II diabetes, as well as between saturated fat consumption and cardiovascular disease.[1,5]

It is worth noting that there were significant differences in diet quality between the Midwest and Southwest regions. This might be explained in part by differences in culture, dietary traditions and preferences, and the different points in history at which they faced colonization. Traditional diets of both regions include corn, beans, squash, potatoes, and root vegetables, along with wild game, fish, wild rice, and berries in the Midwest, and mutton, piñon nuts, and tortillas in the Southwest.[6] It is possible that the Southwest communities in this study have been better able to maintain (or restore) access to traditional food preferences post-colonization than those communities in the Midwest.

Nutrition knowledge showed no association with diet quality among study participants. Applying the SCT in the context of health promotion[12] may help to explain this result, as it is hypothesized that psychosocial factors like self-efficacy and intentions for healthier eating are more proximal to diet quality than nutrition knowledge.[20] Another potential explanation is that most studies to date have not separated declarative knowledge (ie. knowing facts) from procedural knowledge (ie. knowing how to perform actions), the latter of which may have a stronger relationship with diet quality.[36] It is also plausible that in the NA communities in this study, the pathway between nutrition knowledge and diet quality is influenced by other factors such as food insecurity and lack of access to healthy foods.[7,37–40] Tribal lands have a lower density of healthy food outlets, even compared to non-tribal lands of similar rurality and per capita income,[16] which creates a barrier between healthy eating intentions and the purchase or consumption of healthy food.

Seventy-four percent of study participants reported receiving some form of food assistance, which is much higher than the 25% of all NAs who participate in food assistance programs nationally, but in line with estimates of food assistance among NAs living on some reservations and tribal communities.[41] Although only a small proportion (less than 15%) of this sample reported receiving FDPIR, it was the only food assistance program under investigation associated with significantly lower diet quality. Recent work has drawn attention to the need for revisions to FDPIR, in particular advocating for inclusion of traditional culturally-relevant foods, which would be an important step toward addressing diet quality and food sovereignty issues.[42]

Although a healthier household food pattern score was positively associated with greater total HEI in this study population, the sub-component score for eating meals together with others was not related to diet quality. This conflicts with a considerable body of evidence that shared meals are associated with better diet quality in children, adults, and the elderly.[43] It is possible that limited access to healthy foods in rural tribal areas impedes this association.

Total HEI was significantly lower among those who reported having no comorbidities as compared to those who reported presence of any comorbidity. This conflicts with prior research that has found poorer diet quality to be associated with the prevalence of comorbidities.[44,45] One potential explanation is that the people in this sample who reported being diagnosed with a diet-related chronic condition may have made subsequent changes to their dietary habits in order to prevent further illness, though this hypothesis can not be tested in a baseline dataset.

Study Limitations

Several limitations should be considered when interpreting these results. While a FFQ is the most feasible epidemiological tool to measure dietary patterns at a population level, it is prone to response bias (participants reporting the foods they feel are most socially acceptable) and recall bias (over-reporting recently-consumed foods and under-reporting foods that were consumed toward the beginning of the 1-month recall period). In addition the validity and reliability of the FFQ, AIQ, and HEI have not been well-studied in NA populations.

The Cronbach's alpha and Kuder-Richardson formula 20 values for the psychosocial factors measured in this study are low. This may be due to the low number of questions (<10) in each scale.[46] Although face validity of the AIQ was tested in 2 NA communities, it could be performing differently in other communities. Despite this, however, the reliability statistics for these scales can still be considered informative.[47,48]

There are over 500 federally-recognized tribes in the United States, each with unique identities, cultures, and dietary practices.[7] It is therefore impossible for any study to be representative of all NAs. The generalizability of these study results may also be limited by the unique characteristics of the study population: participants identified themselves as the main food shopper/preparer for their households, and the majority were female. Further, because participants were living on reservations in rural tribal communities, their characteristics may differ from NAs living elsewhere.

IMPLICATIONS FOR RESEARCH, PRACTICE, AND POLICY

The prevalence of obesity and food assistance in this sample is not only higher than in the general U.S. population, but also higher than NA averages reported in national survey data. This is symptomatic of the extra burden from socioeconomic, health, and dietary disparities experienced by NAs living in food deserts on reservations and remote communities, and indicative of the need for innovative long-term interventions to address the root causes of these problems.

The findings in this study support the use of social-cognitive intervention approaches in reservation-based communities in the Midwest and Southwest, given that several psychosocial factors were associated with diet quality. The finding that FDPIR was associated with lower diet quality also warrants further exploration, since nearly 40% of FDPIR participants nationally use commodity foods as their sole food source.[19]

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REFERENCES

1. Jacobs-Wingo JL, Espey DK, Groom AV., Phillips LE, Haverkamp DS, Stanley SL. Causes and disparities in death rates among Urban American Indian and Alaska native populations, 1999–2009. Am J Public Health. 2016;106(5):906–914. doi:10.2105/AJPH.2015.303033 [PubMed: 26890168]
2. Watts V, Rockett H, Baer H, Colditz G. Assessing diet quality in a population of low-income pregnant women: A comparison between native Americans and whites. Matern Child Health J. 2007;11(2):127–136. doi:10.1007/s10995-006-0155-2 [PubMed: 17191147]
3. Ferranti EP, Hartman TJ, Elliott AJ, et al. Diet Quality of Pregnant American Indian Women in the Northern Plains. Prev Chronic Dis 2019;16:180536. doi:10.5888/pcd16.180536
4. Byker Shanks C, Ahmed S, Dupuis V, et al. Dietary Quality Varies Among Adults on the Flathead Nation of the Confederated Salish and Kootenai Tribes in Montana. J Community Health. 10 2019:1–12. doi:10.1007/s10900-019-00753-3 [PubMed: 29936641]
5. Cobb N, Espey D, King J. Health behaviors and risk factors among American Indians and Alaska Natives, 2000û2010. Am J Public Health. 2014;104(SUPPL. 3). doi:10.2105/AJPH.2014.301879
6. Park S, Hongu N, Daily JW. Native American foods: History, culture, and influence on modern diets. J Ethn Foods. 2016;3(3):171–177. doi:10.1016/j.jef.2016.08.001
7. Vernon R A Native Perspective: Food is More Than Consumption. J Agric Food Syst Community Dev. 9 2015:1–6. doi:10.5304/jafscd.2015.054.024
8. Wang Y, Chen X. How much of racial/ethnic disparities in dietary intakes, exercise, and weight status can be explained by nutrition- and health-related psychosocial factors and socioeconomic status among US adults? J Am Diet Assoc. 2011;111(12):1904–1911. doi:10.1016/j.jada.2011.09.036 [PubMed: 22117667]
9. Wang Y, Chen X. Between-group differences in nutrition- and health-related psychosocial factors among US adults and their associations with diet, exercise, and weight status. J Acad Nutr Diet. 2012;112(4):486–498.e3. doi:10.1016/j.jand.2011.12.003 [PubMed: 22709700]
10. Sharma SV, Gernand AD, Day RS. Nutrition knowledge predicts eating behavior of all food groups except fruits and vegetables among adults in the Paso del Norte region: Qué Sabrosa Vida. J Nutr Educ Behav. 2008;40(6):361–368. doi:10.1016/j.jneb.2008.01.004 [PubMed: 18984492]
11. Fila SA, Smith C. Applying the Theory of Planned Behavior to healthy eating behaviors in urban Native American youth. Int J Behav Nutr Phys Act. 2006;3. doi:10.1186/1479-5868-3-11 [PubMed: 16503980]
12. Bandura A Health promotion by social cognitive means. Heal Educ Behav. 2004;31(2):143–164. doi:10.1177/1090198104263660
13. Anderson ES, Winett RA, Wojcik JR. Self-regulation, self-efficacy, outcome expectations, and social support: Social cognitive theory and nutrition behavior. Ann Behav Med. 2007;34(3):304–312. doi:10.1007/BF02874555 [PubMed: 18020940]
14. Byrd-Bredbenner C, Abbot JM, Cussler E. Relationship of social cognitive theory concepts to mothers' dietary intake and BMI. Matern Child Nutr. 2011;7(3):241–252. doi:10.1111/j.1740-8709.2009.00232.x [PubMed: 21689267]
15. Manios Y, Moschonis G, Katsaroli I, Grammatikaki E, Tanagra S. Changes in diet quality score, macro - And micronutrients intake following a nutrition education intervention in postmenopausal women. J Hum Nutr Diet. 2007;20(2):126–131. doi:10.1111/j.1365-277X.2007.00750.x [PubMed: 17374025]
16. Chodur GM, Shen Y, Kodish S, et al. Food environments around American Indian reservations: A mixed methods study. PLoS One 2016;11(8). doi:10.1371/journal.pone.0161132
17. Wetherill MS, Williams MB, Taniguchi T, et al. A Nutrition Environment Measure to Assess Tribal Convenience Stores: The THRIVE Study. Health Promot Pract 9 2018:1524839918800968. doi:10.1177/1524839918800968
18. Jernigan VBB, Wetherill MS, Hearod J, et al. Food insecurity and chronic diseases among American Indians in rural Oklahoma: The THRIVE study. Am J Public Health. 2017;107(3):441–446. doi:10.2105/AJPH.2016.303605 [PubMed: 28103070]

19. Pindus N, Hafford C. Food security and access to healthy foods in Indian country: Learning from the Food Distribution Program on Indian Reservations. J Public Aff 2019;19:e1876. doi:10.1002/pa.1876
20. Gittelsohn J, Anliker JA, Sharma S, Vastine AE, Caballero B, Ethelbah B. Psychosocial Determinants of Food Purchasing and Preparation in American Indian Households. J Nutr Educ Behav. 2006;38(3):163–168. doi:10.1016/j.jneb.2005.12.004 [PubMed: 16731451]
21. Story M, Neumark-Sztainer D, Resnick MD, Blum RW. Psychosocial Factors and Health Behaviors Associated with Inadequate Fruit and Vegetable Intake among American-Indian and Alaska-Native Adolescents. J Nutr Educ. 1998;30(2):100–106. doi:10.1016/S0022-3182(98)70286-9
22. Rinderknecht K, Smith C. Social cognitive theory in an after-school nutrition intervention for urban Native American youth. J Nutr Educ Behav. 2004;36(6):298–304. doi:10.1016/S1499-4046(06)60398-9 [PubMed: 15617611]
23. Gittelsohn J, Jock B, Redmond L, et al. OPREVENT2: Design of a multi-institutional intervention for obesity control and prevention for American Indian adults. BMC Public Health. 2017;17(1):1–9. doi:10.1186/s12889-017-4018-0 [PubMed: 28049454]
24. Bronfenbrenner U Toward an experimental ecology of human development. Am Psychol. 1977;32(7):513–531. doi:10.1037/0003-066x.32.7.513
25. Dettwyler KA. Anthropometric standardization reference manual, abridged edition. Edited by Lohman Timothy G., Roche Alex F, and Martoll Reynaldo. Champaign, Illinois: Human Kinetic Books 1991 90 pp.
26. Mulasi-Pokhriyal U, Smith C. Comparison of the Block Kid's Food Frequency Questionnaire with a 24 h dietary recall methodology among Hmong-American children, 9–18 years of age. Br J Nutr. 2013;109(2):346–352. doi:10.1017/S0007114512001043 [PubMed: 22716765]
27. Baer HJ, Blum RE, Rockett HRH, et al. Use of a food frequency questionnaire in American Indian and Caucasian pregnant women: A validation study. BMC Public Health 2005;5. doi:10.1186/1471-2458-5-135 [PubMed: 15647120]
28. Block G, Thompson FE, Hartman AM, Larkin FA, Guire KE. Comparison of two dietary questionnaires validated against multiple dietary records collected during a 1-year period. J Am Diet Assoc. 1992;92(6):686–693. [PubMed: 1607564]
29. Block G, Hartman AM, Naughton D. A reduced dietary questionnaire: Development and validation. Epidemiology. 1990;1(1):58–64. doi:10.1097/00001648-199001000-00013 [PubMed: 2081241]
30. Lee ET, Welty TK, Fabsitz R, et al. The strong heart study a study of cardiovascular disease in American Indians: Design and methods. Am J Epidemiol. 1990;132(6):1141–1155. doi:10.1093/oxfordjournals.aje.a115757 [PubMed: 2260546]
31. Reedy J, Lerman JL, Krebs-Smith SM, et al. Evaluation of the Healthy Eating Index-2015. J Acad Nutr Diet 2018;118(9):1622–1633. doi:10.1016/j.jand.2018.05.019 [PubMed: 30146073]
32. Young TK. Recent Health Trends in the Native American Population. Vol 16 National Academies Press (US); 1997. doi:10.1023/A:1005793131260
33. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Heal Organ - Tech Rep Ser 2000;894.
34. Kolahdooz F, Butler L, Lupu M, Sheehy T, Corriveau A, Sharma S. Assessment of dietary intake among Inuvialuit in Arctic Canada using a locally developed quantitative food frequency questionnaire. J Am Coll Nutr. 2014;33(2):147–154. doi:10.1080/07315724.2013.874890 [PubMed: 24724772]
35. U.S. Department of Agriculture. Average Healthy Eating Index 2015 Scores for Amerians by Age Group.; 2018 http://www.health.gov/dietaryguidelines/2015/guidelines/ Accessed March 8, 2020.
36. Dickson-Spillmann M, Siegrist M. Consumers' knowledge of healthy diets and its correlation with dietary behaviour. J Hum Nutr Diet. 2011;24(1):54–60. doi:10.1111/j.1365-277X.2010.01124.x [PubMed: 20880377]
37. Gurney RM, Caniglia BS, Mix TL, Baum KA. Native American Food Security and Traditional Foods: A Review of the Literature. Sociol Compass 2015;9(8):681–693. doi:10.1111/soc4.12284

38. Fretts AM, Huber C, Best LG, et al. Availability and Cost of Healthy Foods in a Large American Indian Community in the North-Central United States. Prev Chronic Dis 2018;15:170302. doi:10.5888/pcd15.170302
39. Kumar G, Jim-Martin S, Piltch E, et al. Healthful Nutrition of Foods in Navajo Nation Stores. Am J Heal Promot 2016;30(7):501–510. doi:10.4278/ajhp.140821-QUAN-422
40. Kaufman P, Dicken C, Williams R. Measuring Access to Healthful, Affordable Food in American Indian and Alaska Native Tribal Areas. USDA Bulletin EIB-131, 12 2014 http://www.ers.usda.gov/webdocs/publication/43905/49690_eib131_errata.pdf Accessed May 5, 2020.
41. Jernigan VBB, Huyser KR, Valdes J, Simonds VW. Food Insecurity Among American Indians and Alaska Natives: A National Profile Using the Current Population Survey–Food Security Supplement. J Hunger Environ Nutr 2017;12(1):1–10. doi:10.1080/19320248.2016.1227750 [PubMed: 28491205]
42. Mucioki M, Sowerwine J, Sarna-Wojcicki D. Thinking inside and outside the box: local and national considerations of the Food Distribution Program on Indian Reservations (FDPIR). J Rural Stud. 2018;57:88–98. doi:10.1016/j.jrurstud.2017.11.002
43. Fulkerson JA, Larson N, Horning M, Neumark-Sztainer D. A review of associations between family or shared meal frequency and dietary and weight status outcomes across the lifespan. J Nutr Educ Behav. 2014;46(1):2–19. doi:10.1016/j.jneb.2013.07.012 [PubMed: 24054888]
44. Hung HC, Joshipura KJ, Jiang R, et al. Fruit and vegetable intake and risk of major chronic disease. J Natl Cancer Inst. 2004;96(21):1577–1584. doi:10.1093/jnci/djh296 [PubMed: 15523086]
45. Aune D, Giovannucci E, Boffetta P, et al. Aune et. al 2017. Int J Epidemiol. 2017;46(3):1029. doi:10.1093/IJE/DYW319 [PubMed: 28338764]
46. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ. 2011;2:53–55. doi:10.5116/ijme.4dfb.8dfd [PubMed: 28029643]
47. Schmitt N. Uses and abuses of coefficient alpha. Psychol Assess. 1996;8(4):350–353. doi:10.1037/1040-3590.8.4.350
48. Sijtsma K On the use, the misuse, and the very limited usefulness of cronbach's alpha. Psychometrika. 2009;74(1):107–120. doi:10.1007/s11336-008-9101-0 [PubMed: 20037639]

Table 1.

Individual and Household Characteristics Associated with HEI-2015 in Rural Native American Adults

		HEI Total		HEI Saturated Fat		HEI Refined Grain		HEI Refined Sugars		HEI Sodium	
	n (580)	Mean Score (SD)	P	Mean Score (SD)	P	Mean Score (SD)	P	Mean Score (SD)	P	Mean Score (SD)	P
Individual Characteristics											
Sex											
Male	151	47.6(7.7)		4.0(2.4)		9.0(1.6)		3.4(2.7)		4.1(2.5)	
Female	429	49.8(8.1)	0.002	4.2(2.6)	0.106	9.0(1.7)	0.731	3.4(2.8)	0.847	4.9(2.4)	0.001
Age (years)											
18–45	275	48.5(8.0)		4.4(2.4)		8.9(1.7)		3.0(2.6)		4.9(2.4)	
≥46	305	49.9(8.1)	0.048	4.0(2.6)	0.041	9.0(1.6)	0.785	3.8(2.8)	<0.001	4.4(2.5)	0.021
Education											
≤ GED/Diploma	313	48.4(7.8)		4.2(2.4)		8.9(1.8)		3.4(2.8)		4.7(2.5)	
≥ Some college/ technical school	262	50.2(8.3)	0.007	4.1(2.6)	0.831	9.0(1.5)	0.116	3.4(2.7)	0.754	4.6(2.4)	0.709
BMI (kg/m^2)											
<25	84	48.1(8.5)	0.177	4.3(2.5)	0.509	9.0(1.5)	0.564	2.6(2.7)	0.006	4.9(2.7)	0.290
25–29.9	137	49.0(8.2)	0.614	4.0(2.6)	0.532	9.1(1.5)	0.128	3.4(2.8)	0.809	4.5(2.4)	0.475
30–34.9	178	48.7(7.2)	0.210	4.2(2.5)	0.920	8.6(1.8)	0.003	3.7(2.8)	0.050	4.6(2.5)	0.588
35–39.9	91	50.3(8.6)	0.227	4.3(2.4)	0.584	9.1(1.6)	0.544	3.3(2.8)	0.831	4.8(2.3)	0.405
≥40	50	49.5(8.3)	0.804	4.2(2.4)	0.948	8.9(1.7)	0.919	3.2(2.5)	0.513	4.8(2.6)	0.776
Employment status[1]											
Unemployed[2]	247	49.1(7.8)		4.2(2.5)		8.9(1.7)		3.5(2.7)		4.6(2.4)	
Employed[3]	329	49.3(8.3)	0.542	4.1(2.5)	0.601	9.0(1.6)	0.498	3.3(2.8)	0.903	4.7(2.5)	0.936
Comorbidities											
HTN	181	49.6(8.1)		4.2(2.7)		9.1(1.7)		3.5(2.7)		4.5(2.5)	
No HTN	378	49.2(8.1)	0.569	4.1(2.5)	0.792	8.9(1.6)	0.329	3.4(2.8)	0.631	4.7(2.4)	0.376
DM Type II	114	49.1(8.2)		3.6(2.7)		9.0(1.6)		4.4(2.7)		4.1(2.4)	
No DM Type II	453	49.9(7.7)	0.387	4.3(2.5)	0.027	8.9(1.7)	0.547	3.2(2.7)	<0.001	4.8(2.3)	0.004
Heart Disease	27	50.5(6.5)		4.0(2.6)		8.8(1.7)		4.9(2.8)		3.7(2.5)	
No Heart Disease	541	49.3(8.2)	0.356	4.2(2.5)	0.789	9.0(1.7)	0.471	3.3(2.7)	0.006	4.7(2.4)	0.057
Any comorbidity	424	49.9(8.0)		4.2(2.6)		9.0(1.6)		3.6(2.7)		4.6(2.5)	
			0.002	4.0(2.4)	0.448	8.9(1.8)	0.934	3.0(2.7)	0.024	4.7(2.4)	0.745
No comorbidity	156	47.5(8.0)									
Current Smoker											
No	411	50.1(8.0)		4.4(2.5)		8.8(1.8)		3.6(2.7)		4.5(2.5)	
Yes	163	47.1(7.8)	<0.001	3.6(2.6)	<0.001	9.5(1.2)	<0.001	2.8(2.7)	0.003	4.9(2.3)	0.127
Household Characteristics											

		HEI Total		HEI Saturated Fat		HEI Refined Grain		HEI Refined Sugars		HEI Sodium	
	n (580)	**Mean Score (SD)**	**P**	**Mean Score (SD)**	**P**	**Mean Score (SD)**	**P**	**Mean Score (SD)**	**P**	**Mean Score (SD)**	**P**
Food Assistance											
SNAP (vs no SNAP)	229	49.1(7.6)	0.673	4.3(2.6)	0.224	8.8(1.7)	0.219	3.4(2.8)	0.929	4.8(2.5)	0.359
FDPIR (vs no FDPIR)	85	46.9(6.8)	0.001	3.4(2.3)	0.003	8.8(1.8)	0.311	3.9(2.6)	0.57	4.2(2.2)	0.048
Other (vs none)	292	49.6(8.0)	0.225	4.1(2.5)	0.588	8.8(1.8)	0.077	3.7(2.8)	0.004	4.5(2.4)	0.067
None (vs any)	149	49.3(8.6)	0.894	4.1(2.6)	0.995	9.2(1.4)	0.004	3.0(2.8)	0.021	4.9(2.5)	0.107
Geographic Location											
Southwest	384	50.4(8.1)		4.5(2.4)		8.7(1.9)		3.5(2.7)		4.7(2.4)	
Midwest	196	47.0(7.6)	<0.001	3.5(2.6)	<0.001	9.5(1.1)	<0.001	3.1(2.8)		4.5(2.5)	
Household Size											
1	67	48.9(7.9)	0.942	3.6(2.5)	0.064	9.0(1.9)	0.690	3.9(3.2)	0.150	3.9(2.4)	0.007
2–4	346	49.5(8.6)	0.863	4.2(2.6)	0.478	8.9(1.7)	0.281	3.4(2.6)	0.785	4.7(2.5)	0.345
≥5	166	49.3(7.6) 0.070		4.3(2.4)	0.489	9.1(1.5)	0.363	3.2(2.8)	0.322	4.8(2.3)	0.314
Interview Month											
April-October	158	48.6(8.0)		4.1(2.5)		8.8(1.9)		3.5(2.7)		4.4(2.4)	
November-March	422	49.5(8.1)	0.195	4.2(2.6)	0.808	9.0(1.6)	0.140	3.3(2.7)	0.503	4.7(2.5)	0.247

Abbreviations: HEI (Healthy Eating Index); SD (standard deviation); GED (General Education Development Test); BMI (Body Mass Index); HTN (Hypertension); DM (Diabetes Mellitus), SNAP (Supplemental Nutrition Assistance Program); FDPIR (Food Distribution Program on Indian Reservations)

"Other" food assistance includes those who indicated using WIC, food pantries, church food donations, and any other forms of food assistance not listed in the survey Statistical tests used: two-tailed t-test, one-way ANOVA

[1] 1.1% refused to answer

[2] Includes unemployed, not employed, student, retired, disabled

[3] Includes full-time, part-time, seasonal/temporary work, self employed

Table 2.

Psychosocial Factors Associated with HEI-2015 in Rural Native American Adults

Psychosocial Factors	n	HEI-2015 B (SE)	P	HEI Saturated Fat B (SE)	P	HEI Refined Grain B (SE)	P	HEI Added Sugar B (SE)	P	HEI Sodium B (SE)	P
Intentions Score	567	0.78 (0.12)	<0.001	0.16(0.04)	<0.001	−0.03(0.03)	0.082	0.04(0.04)	0.305	−0.03(0.04)	0.837
Self-Efficacy Score	570	0.97 (0.16)	0.001	0.08(0.05)	0.967	0.05(0.03)	0.067	−0.02(0.06)	0.545	−0.08(0.05)	0.117
Nutrition Knowledge Score	580	0.00 (0.18)	0.502	0.01(0.06)	0.449	0.01(0.04)	0.703	−0.01(0.06)	0.186	0.04(0.05)	0.888

Abbreviations: HEI (Healthy Eating Index), B (linear regression coefficient) SE (standard error)

Statistical test used: Multiple linear regression adjusted for age, sex, education, smoking, clustered by community (6 communities) n indicates number of responses included in analysis due to missing data

Table 3.

Household Food Practices Associated with HEI-2015 in Rural Native American Adults, n=576

Household food practices	HEI-2015		HEI Saturated Fat		HEI Refined Grain		HEI Added Sugar		HEI Sodium	
	B (SE)	P	B (SE)	P	B (SE)	P	B (SE)	P	B (SE)	P
Total Score	0.48(0.15)	0.001	0.06(0.05)	0.255	−0.02(0.03)	0.517	−0.01(0.05)	0.792	0.06(0.05)	0.204
Meal Planning/ Shopping List	0.67(0.33)	.0.161	0.16(0.11)	0.162	−0.01(0.07)	0.850	−0.17(0.11)	0.138	0.03(0.10)	0.806
Eating Meals with Others	0.65(0.35)	0.384	0.06(0.11)	0.985	−0.08(0.07)	0.406	0.00(0.12)	0.844	0.17(0.15)	0.047
Bringing Home Prepared Foods	−0.63(0.45)	0.106	−0.06(0.14)	0.754	−0.07(0.09)	0.647	−0.09(0.15)	0.409	0.18(0.14)	0.292
Preparing Foods with Others	0.72(0.32)	0.106	0.04(0.10)	0.848	−0.03(0.07)	0.979	0.04(0.11)	0.681	0.12(0.10)	0.884

Abbreviations: HEI (Healthy Eating Index), B (linear regression coefficient), SE (standard error)

Statistical test used: multiple linear regression, adjusted for age, sex, education, smoking, clustered by community (6 communities)