



Healthy Stores Initiative Associated with Produce Purchasing on Navajo Nation

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ABSTRACT

Background: American Indians and Alaska Natives experience diet-related health disparities compared with non-Hispanic whites. Navajo Nation's colonial history and remote setting present unique challenges for healthy food access.

Objective: This study aims to understand the impact of the Healthy Navajo Stores Initiative (HNSI) on fruit and vegetable purchasing on Navajo Nation.

Methods: We conducted a cross-sectional survey of 692 customers shopping at 28 convenience stores, trading posts, and grocery stores on Navajo Nation. Individual- and household-level sociodemographic data and food purchasing behaviors were collected. Descriptive and bivariate analyses for customers' individual- and household-level characteristics were conducted using chi-squared tests. The impact of individual-, household-, and store-level factors on fruit and vegetable purchasing was assessed using multiple logistic regression modeling.

Results: Store participation in the HNSI was significantly associated with customers' purchase of produce. Customers experienced 150% higher odds of purchasing produce if they shopped in participating stores, compared with nonparticipating stores ($P < 0.001$). Store type was strongly associated with customers' purchase of fruits or vegetables. Customers shopping at a grocery store had 520% higher odds of purchasing produce than did customers shopping at convenience stores ($P < 0.001$). Customers shopping at trading posts had 120% higher odds of purchasing fruits or vegetables than did customers shopping at convenience stores ($P = 0.001$).

Conclusions: Our findings reveal increased produce purchasing at stores participating in the HNSI. Customers were significantly more likely to purchase fruits or vegetables in stores enrolled in a healthy store intervention than in nonenrolled stores, after controlling for quantity of produce stocked and store type. Customers shopping in grocery stores and trading posts were significantly more likely to purchase produce than customers shopping in convenience stores. These findings have implications for food access in rural tribal communities. *Curr Dev Nutr* 2019;3:nzz125.

Keywords: health promotion/methods, fruits, vegetables, American Indians, Alaska Natives, adult, health behavior, health disparity

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Abbreviations used: AI/AN, American Indian/Alaska Native; FDIPIR, Food Distribution Program on Indian Reservations; FVI, Fruit and Vegetable Index; FVRx, Fruit and Vegetable Prescription Program; HNSI, Healthy Navajo Stores Initiative; NEMS-S, Nutrition Environment Measurement Survey in Stores; RWJF, Robert Wood Johnson Foundation; SNAP, Supplemental Nutrition Assistance Program.

Introduction

American Indians and Alaska Natives (AI/ANs) experience health disparities compared with the general US population (1). AI/AN individuals are more than twice as likely to have diabetes and obesity as are non-Hispanic whites (2–4). These health disparities are likely in part due to high poverty levels, access barriers and discrimination in health

care delivery, and a long history of racist laws and policies that have systematically disrupted indigenous food systems (5–9).

These structural factors contribute to limited healthy, affordable food access in AI/AN communities, particularly on rural reservations. A recent USDA study found that only 25.6% of all tribal communities lived within 1 mile of a supermarket, compared with 58.8% of the general US population (10). Grocery store inaccessibility has been shown to

be associated with decreased shopping frequency and increased obesity prevalence (11). In contrast, local affordability and variety of produce are associated with increased purchasing and consumption (12, 13). In addition to geographic barriers, food access is also limited by disproportionately high poverty rates experienced by AI/AN individuals and communities. One-half of all AI/AN individuals have incomes $\leq 200\%$ of the Federal Poverty Level (10).

Navajo Nation provides an exemplar of these structural challenges and their resulting impact on health outcomes. Almost the entire Navajo Nation is classified as a food desert by the USDA (14). Only 13 grocery stores operate within the reservation, an area the size of West Virginia (15). Grocery stores and small retailers on Navajo Nation predominately offer highly processed foods with low nutritional value, and at higher prices than off-reservation stores (6, 15, 16). Stores on Navajo Nation stock limited varieties and quantities of fruits and vegetables [(6); unpublished Navajo Nutrition Environment Measurement Survey in Stores (NEMS-S) assessment conducted by the authors]. This combination of limited accessibility to grocery stores and high prices has tangible impacts on food security and health. Navajo Nation's food insecurity rates are among the highest reported in the United States, at 76.7% (17, 18). Household food insecurity is associated with increased risks of overweight, obesity, hypertension, and type 2 diabetes (19–22).

Responding to this challenge, our organization launched the Healthy Navajo Stores Initiative (HNSI) in 2014. This was a multifaceted intervention, drawing from national “Healthy Corner Store” best practices. Store owners across Navajo Nation were invited to participate in the HNSI; if they accepted, our team helped owners identify and implement changes in 4 areas: store environment, promotion, staff training, and participation in a local food voucher program. Environmental changes included produce placement in the front of the store or at the points of sale, as well as acquisition of produce shelves and coolers. Stores were offered free, culturally adapted promotional materials including shelf talkers, labels, and recipe cards to promote produce. We offered staff training on produce handling to maintain freshness and promote longevity. Stores that met predefined produce stocking requirements were also invited to participate in a local voucher program, the Navajo Fruit and Vegetable Prescription Program (FVRx), in which local health care teams prescribed vouchers to families with children or mothers at risk of obesity, diabetes, or food insecurity. “FVRx stores” were qualified to accept vouchers from families in turn, receiving reimbursement for the vouchers via our organization.

The objective of this study was to investigate if the HNSI was associated with increased produce purchasing on Navajo Nation. We hypothesized that store participation in the intervention was associated with customer produce purchasing, compared with nonparticipating stores. A secondary aim of the study was to identify other individual and store characteristics associated with healthier purchasing behavior.

Methods

Study setting

The Navajo Nation is located in the Four Corners region of the Southwest United States, spanning 27,000 square miles in New Mexico, Arizona, and Utah. In 2013, we collected data on stores from a 2011 national proprietary data set of businesses from InfoUSA, supplemented

with information from the Yellow Pages and calls to all local communities (Chapters). InfoUSA uses standardized criteria verified by businesses to assign Standard Industrial Classification to define the store type. A total of 13 grocery stores and 99 small stores were identified on Navajo Nation.

We also categorized stores into 3 groups. Convenience stores are small stores that are corporately owned, attached to a gas station, and often stock snack foods and limited amounts of grocery items. By contrast, trading posts are independently owned stores that often stock groceries, many of which are dried or canned goods; traditional food items (e.g., blue corn meal, juniper berries); and Navajo-made pottery, rugs, and jewelry. Finally, grocery stores are larger stores that stock a wide variety of food items.

Sampling approach

From June to December 2016, we conducted a cross-sectional survey of customers at 28 stores (5 grocery, 16 convenience, and 7 trading posts) on Navajo Nation. Stores participating in the HNSI were matched with nonparticipating stores, based on the baseline (2013) Fruit and Vegetable Index (FVI), a measure of the quantity of fruits and vegetables stocked in a store. At the time of the survey period, stores had participated in the HNSI for ≥ 1 y.

The day and time of each customer intercept survey were randomized using computer-generated assignment based on 3 variables: weekday/weekend, beginning/end of month, and AM/PM. Surveys were conducted within the randomly assigned time and day constraints at each store. A minimum of 2 different store visits to intercept customers were made at each store to provide a broader sample of shopping behavior. Each of the 2 visits per store was randomized separately. The study team aimed to intercept 12–15 customers at each store visit, for a total goal of 30 customers per store. In 5 stores, low numbers of shoppers necessitated > 2 visits to conduct surveys.

Customers exiting the store were consecutively approached during each store visit. Customer eligibility criteria included 1) 18 y of age or older; 2) not currently pregnant or breastfeeding; 3) a primary food shopper in their household; and 4) living on Navajo Nation. Willing customers were interviewed by trained research assistants outside of stores. Among 739 customers approached, 692 customers met the eligibility criteria and were surveyed. Information on customers who refused to participate was not collected, but the main reason for refusal was lack of time.

Data collection

Tablet-based surveys were conducted by 7 trained Navajo research assistants and the study supervisor. Participants were given a reusable grocery bag and water bottle upon completion of the survey. On average, the survey took 7 min to complete.

All project evaluation was approved by the Navajo Nation Human Research Review Board and deemed exempt by Partners Healthcare Institutional Review Board.

Measurements

The consumer intercept survey used in this study was adapted from previous studies (13, 23) for use in a multiphase longitudinal study to evaluate the HNSI. The survey instrument (**Supplement 1**) was pilot tested at 3 distinct store locations. Feedback from Navajo staff and

RWJF recommendations	FVI for Navajo Nation
<p>BASIC</p> <ul style="list-style-type: none"> • Four varieties of qualifying fruits, ≤ 2 of which may be canned or frozen AND • Six varieties of qualifying vegetables, ≤ 2 of which may be canned or frozen • At least 1 vegetable variety must be dark green or red/orange, as defined by USDA • In total, ≥ 30 pounds of qualifying fruits and vegetables • No more than 50% of minimum eligible stock from 1 variety <p>PREFERRED</p> <ul style="list-style-type: none"> • Six varieties of qualifying fruits, ≤ 3 of which may be canned or frozen AND • Eight varieties of qualifying vegetables, ≤ 4 of which may be canned or frozen • At least 2 vegetable varieties must be dark green or red/orange, as defined by USDA • In total, ≥ 45 pounds of qualifying fruit and vegetables • No more than 50% of the total stock being from 1 variety 	<p>BASIC</p> <ul style="list-style-type: none"> • Does not meet criteria for GOOD or EXCELLENT <p>GOOD</p> <ul style="list-style-type: none"> • At least 4 varieties of qualifying fruits, ≥ 2 of which must be fresh AND • At least 6 types of vegetables, ≥ 4 of which must be fresh. To qualify, frozen vegetables must have low or no sodium content, and frozen fruit must have no added sugar <p>EXCELLENT</p> <ul style="list-style-type: none"> • At least 6 different types of fruit, ≥ 3 of which must be fresh AND • At least 8 types of vegetables, ≥ 4 of which must be fresh
<p>* All products must be nonexpired and non-spoiled. Qualifying varieties of canned and frozen fruit must be packed in water, 100% juice, extra-light syrup, or light syrup, with no other added ingredients. Canned and frozen vegetables must have no added ingredients except water or a small amount of sugar for processing purposes to maintain the quality and structure of the vegetable, and must be low sodium (≤ 240 mg/serving). The following may not be included to meet the minimum stock: fruit or vegetable juice, garlic, herbs, condiments, ginger root, lemons, and limes.</p>	<p>* All products must be nonexpired and non-spoiled. Qualifying varieties may be frozen or fresh, but not canned. Frozen fruit must have no added sugar and frozen vegetables must be sodium-free or low sodium (≤ 240 mg/serving). The following may not be included to meet the minimum stock: fruit or vegetable juice, garlic, herbs, condiments, ginger root, or different types of the same item (e.g., 2 varieties of apples only counts as 1 qualifying item).</p>

FIGURE 1 Small store produce stocking levels—RWJF recommendations and the FVI. FVI, Fruit and Vegetable Index; RWJF, Robert Wood Johnson Foundation.

community members regarding word choice, reading level, and cultural competency was incorporated. Although the final survey was deemed comprehensible and culturally appropriate by Navajo stakeholders, formal validation of the survey instrument was not conducted.

Food shopping behavior questions included where customers did the majority of their food shopping, shopping frequency at the current store, and knowledge of whether the current store sold fresh fruits and vegetables. Customers were first asked if they had bought any fresh or frozen fruits or vegetables that day at the store. Customers were presented with a list of fresh and frozen produce items, including photos, from which to choose. The food items included 1) fresh fruits (12 types and an “other” category); 2) frozen fruits (8 types and an “other” category); 3) fresh vegetables (16 types and an “other” category); and 4) frozen vegetables (14 types and an “other” category). Customers were then asked if they had bought any fresh or frozen fruits or vegetables within the past week at the store.

Sociodemographic information collected included age, sex, education, and employment. Household demographic information included size of household, household food security, participation in assistance programs including the Supplemental Nutrition Assistance Pro-

gram (SNAP) and Food Distribution Program on Indian Reservations (FDPIR), electricity in the home, presence of a reliable refrigerator, presence of a sink with running water, food production, usual mode of transport to the store at which the interview occurred, and travel time from home to the current store. Although household food security was not formally measured, we explored food security with the following question: “In the past month, were you worried (at any time) that you wouldn’t have enough food to feed your family?”

Data on the store environment were collected using the NEMS-S (15, 22), which was modified for use in the Navajo Nation by the authors. Store information included type of store (convenience compared with trading post compared with grocery), FVI score, and participation in the HNSI. The FVI score was derived from adapted recommendations by the Robert Wood Johnson Foundation (RWJF) on healthful produce stocking levels for small retail food stores (Figure 1) (24). The RWJF recommendations define 2 categories of stores—“Basic” and “Preferred”—based on the quantity of fruits and vegetables available. With these criteria as a foundation, we used data collected from the Navajo NEMS-S survey and thresholds that were felt to be locally achievable and meaningful to community members

TABLE 1 Individual and household characteristics, by purchase of ≥ 1 fruit or vegetable within the last week¹

Characteristic	n (%) (n = 692)	Did not buy fruits or vegetables (n = 408)	Bought fruits or vegetables (n = 284)	χ^2 P value
Age, y				<0.001
18–29	61 (8.8)	30 (7.4)	31 (11.0)	
30–44	151 (21.9)	70 (17.2)	81 (28.6)	
45–59	255 (36.9)	146 (35.8)	109 (38.5)	
≥ 60	224 (32.4)	162 (39.7)	62 (21.9)	
Sex				0.042
Male	158 (22.9)	104 (25.6)	54 (19.0)	
Female	532 (77.1)	302 (74.4)	230 (81.0)	
Employment				0.44
Employed full time	223 (32.5)	127 (31.4)	96 (34.2)	
Education				0.024
<High school	175 (25.6)	90 (22.4)	85 (30.3)	
High school	365 (53.4)	217 (54.0)	148 (52.7)	
\geq College degree	143 (20.9)	95 (23.6)	48 (17.1)	
Shopping frequency at store				<0.001
Weekly or more	497 (72.2)	257 (63.5)	240 (84.8)	
Biweekly to monthly	138 (20.1)	101 (24.9)	37 (13.1)	
Few times per year	53 (7.7)	47 (11.6)	6 (2.1)	
Transportation to store				0.36
Get a ride or walk	90 (13.1)	57 (14.0)	33 (11.7)	
Drive oneself	599 (86.9)	349 (86.0)	250 (88.3)	
Travel time to store, min				<0.001
≤ 5	163 (23.6)	96 (23.5)	67 (23.6)	
6–30	363 (52.5)	187 (45.8)	176 (62.0)	
31–60	117 (16.9)	84 (20.6)	33 (11.6)	
> 60	49 (7.1)	41 (10.1)	8 (2.8)	
Household size, persons				<0.001
1–2	242 (35.0)	168 (41.2)	74 (26.1)	
3–5	323 (46.7)	175 (42.9)	148 (52.1)	
≥ 6	127 (18.4)	65 (15.9)	62 (21.8)	
Worried about having enough food ²	386 (56.2)	235 (58.0)	151 (53.6)	0.24
Receiving food assistance ^{2,3}	286 (41.3)	142 (34.8)	144 (50.7)	<0.001
Family food production ²	425 (61.4)	246 (60.3)	179 (63.0)	0.47
Household electricity ²	613 (89.2)	366 (90.4)	247 (87.6)	0.25
Household refrigeration ²	621 (90.4)	373 (92.1)	248 (87.9)	0.07
Household running water ²	590 (85.8)	354 (87.4)	236 (83.4)	0.14

¹n = 692. n may not sum to 692 owing to missing data and percentages may not sum to 100% because of rounding.

²Binary variable with only 1 outcome reported.

³Receiving food assistance defined for this study as participation in the Supplemental Nutrition Assistance Program or the Food Distribution Program on Indian Reservations.

to derive the FVI: an “excellent” store must have ≥ 6 different types of fruit, ≥ 3 of which must be fresh, and ≥ 8 types of vegetables, ≥ 4 of which must be fresh. A “good” store must have ≥ 4 types of fruit, ≥ 2 of which must be fresh, and 6 types of vegetables, ≥ 4 of which must be fresh. Only fresh and frozen fruits and vegetables were considered qualifying items, and to qualify, frozen vegetables must have low or no sodium content, and frozen fruit must have no added sugar. HNSI participation by stores was determined based on the list of stores actively participating in the HNSI program via the implementing team. Of note, all HNSI stores were redeeming FVRx vouchers at the time of the survey or had been a redemption site within the past year.

Data analysis

The key outcome variable was fruit or vegetable purchasing, defined as purchase of ≥ 1 type of fruit or vegetables (fresh or frozen) within the last week, at the store of survey completion. The outcome variable of fruit or vegetable purchasing is also referred to as fruits or vegetables purchasing

or produce purchasing throughout the article. The independent variables examined were age, sex, employment, education, household size, household food security, receipt of food assistance, family food production, household electricity, household refrigeration, household running water, shopping frequency, transportation to store, travel time to store, type of store, FVI, and HNSI participation.

Data were analyzed using Stata 14 software (StataCorp LP) (25). Descriptive and bivariate analyses for customers’ individual- and household-level characteristics (Table 1) and for store-level characteristics (Table 2) were conducted using chi-squared tests for categorical data. Descriptive statistics for surveyed stores were calculated using data from the Navajo NEMS-S assessment. Spearman’s rank correlation coefficients were used to assess potential collinearity among independent variables. Multiple logistic regression modeling was used to assess the impact of individual-, household-, and store-level factors on fruit and vegetable purchasing, controlling for potential covariates. The final logistic regression model assesses the impact of factors on fruit and veg-

TABLE 2 Store-level characteristics, by purchase of ≥ 1 fruit or vegetable within the last week¹

Characteristic	n (%) (n = 692)	Did not buy fruits or vegetables (n = 408)	Bought fruits or vegetables (n = 284)	χ^2 P value
Type of store				<0.001
Convenience	381 (55.1)	260 (63.7)	121 (42.6)	
Trading post	177 (25.6)	109 (26.7)	68 (23.9)	
Grocery	134 (19.4)	39 (9.6)	95 (33.5)	
Fruit and Vegetable Index				<0.001
<Good/excellent	277 (40.0)	186 (45.6)	91 (32.0)	
Good/excellent	415 (60.0)	222 (54.4)	193 (68.0)	
HNSI status				<0.001
Non-HNSI store	429 (62.0)	288 (70.6)	141 (49.7)	
HNSI store	263 (38.0)	120 (29.4)	143 (50.4)	

¹n = 692. n may not sum to 692 owing to missing data and percentages may not sum to 100% because of rounding. HNSI, Healthy Navajo Stores Initiative.

etable purchasing, adjusting for age, sex, education, shopping frequency, travel time to store, type of store, FVI, HNSI participation, household size, receipt of food assistance, household refrigeration, and household running water. Variables were included in the model if their unadjusted association with fruit and vegetable purchasing was statistically significant at a level of $P < 0.2$ (Table 3). Logistic regression significance was established at the $P < 0.05$ level.

Results

Individual- and household-level customer characteristics

A total of 692 customers were eligible and consented to be surveyed, providing a participation rate of 93.6% (Table 1). The sample was predominately female (77.1%). The average age of customers was 51.1 y, with 32.4% of respondents being 60 y old or older and only 8.8% of respondents being 18–29 y old. The majority of respondents were employed less than full time (67.5%) and had achieved a high school degree as their highest level of formal education (53.4%). Shopping frequency was relatively high, with 72.2% of customers shopping at the surveyed store at least once per week. A majority of customers drove themselves to the store where they were surveyed (86.9%). Customers' average travel time to the store was 33 min (range: 0–900 min), with 24.0% of respondents traveling >30 min. The majority of customers were surveyed at a convenience store (55.1%) and at a store with a "Good/Excellent" FVI score (60.0%). The average household size was 3.7 people, with 18.4% of customers living in households with >5 people (Table 1). A large proportion of customers reported they were worried about having enough food to feed their family (43.8%) and a similarly large proportion received food assistance through SNAP or FDPIR (41.3%). A majority of customers (61.4%) grew food for consumption, through either personal or family engagement in farming, gardening, or ranching. A relatively large proportion of households did not have electricity (10.8%), reliable refrigeration (9.6%), or running water (14.2%).

Survey store characteristics

The majority of surveyed stores were convenience stores (57.1%), followed by trading posts (25.9%) and grocery stores (18.5%). The majority of surveyed stores (60.7%) met the "Good/Excellent" FVI threshold,

with 39.3% falling below this threshold. At the time of the survey, 35.7% of stores either were current HNSI stores or had been participating sites within the past year.

Bivariate analysis of customer shopping behavior

Customers who purchased any fruits or vegetables tended to be younger than nonproduce purchasers ($P < 0.001$) (Table 1). Among those who purchased produce, a greater proportion were female than among those who did not purchase produce ($P = 0.04$). A greater proportion of customers who purchased fruits or vegetables had completed less than a high school degree, than of customers who did not purchase fruits or vegetables ($P = 0.02$). A greater proportion of produce purchasers shopped at least once per week than of nonproduce purchasers ($P < 0.001$). Decreased travel time was also significantly associated with fruits or vegetables purchase ($P < 0.001$); a greater proportion of customers buying fruits or vegetables traveled ≤ 30 min to the store, than of customers who did not purchase fruits or vegetables. Customers' method of transportation to the store was not significantly associated with purchasing of fruits or vegetables ($P = 0.36$). Full-time employment was also not significantly associated with purchasing of fruits or vegetables ($P = 0.44$).

A greater proportion of customers buying fruits or vegetables lived in larger households, than of those not purchasing produce ($P < 0.001$) (Table 1). Produce purchasing was also significantly associated with participation in food assistance programs; SNAP or FDPIR participants made up a larger proportion of individuals purchasing produce than of those who did not purchase produce ($P < 0.001$). Household food security ($P = 0.24$) and food production ($P = 0.47$) did not significantly vary by purchase of fruits or vegetables. Household electricity ($P = 0.25$), running water ($P = 0.14$), and refrigeration ($P = 0.07$) also did not significantly vary by fruits or vegetables purchase.

Produce purchasing was significantly associated with several store-level factors, including type of store ($P < 0.001$), FVI score ($P < 0.001$), and FVRx participation ($P < 0.001$) (Table 2). A greater proportion of customers purchasing produce shopped at grocery stores, stores with FVI ratings of "Good/Excellent," and stores that re-deemed FVRx prescriptions, than of customers who did not purchase produce.

TABLE 3 Logistic regression model of factors associated with purchase of ≥ 1 fruit or vegetable within the last week¹

Characteristic	Unadjusted OR (95% CI)	χ^2 P value	Adjusted OR (95% CI)	χ^2 P value
Age, y (ref: 18–29)				
30–44	1.1 (0.6, 2.0)	0.709	1.6 (0.8, 3.1)	0.20
45–59	0.7 (0.4, 1.3)	0.255	1.1 (0.6, 2.1)	0.81
≥ 60	0.4 (0.2, 0.7)	0.001	0.5 (0.2, 0.9)	0.034
Sex (ref: male)				
Female	1.5 (1.0, 2.1)	0.043	1.7 (1.1, 2.6)	0.026
Education (ref: <high school)				
High school	0.7 (0.5, 1.0)	0.079	0.6 (0.4, 0.9)	0.019
\geq College degree	0.5 (0.3, 0.8)	0.007	0.4 (0.2, 0.8)	0.006
Shopping frequency at store (ref: weekly or more)				
Biweekly to monthly	0.4 (0.3, 0.6)	<0.001	0.3 (0.2, 0.6)	<0.001
Few times per year	0.1 (0.1, 0.3)	<0.001	0.1 (0.1, 0.4)	<0.001
Travel time to store, min (ref: ≤ 5)				
6–30	1.3 (0.9, 2.0)	0.117	1.4 (0.9, 2.1)	0.18
31–60	0.6 (0.3, 0.9)	0.027	0.6 (0.3, 1.1)	0.12
> 60	0.3 (0.1, 0.6)	0.002	0.5 (0.2, 1.3)	0.16
Store type (ref: convenience store)				
Trading post	1.3 (0.9, 1.9)	0.122	2.2 (1.4, 3.4)	0.001
Grocery store	5.2 (3.4, 8.1)	<0.001	6.2 (3.4, 11.1)	<0.001
Fruit and Vegetable Index (ref: <good/excellent)				
Good/excellent	1.8 (1.3, 2.4)	<0.001	1.5 (1.0, 2.3)	0.07
HNSI store (ref: non-HNSI store)	2.4 (1.8, 3.3)	<0.001	2.5 (1.6, 3.7)	<0.001
Household size, persons (ref: 1–2)				
3–5	1.9 (1.4, 2.7)	<0.001	1.6 (1.0, 2.5)	0.041
≥ 6	2.2 (1.4, 3.4)	<0.001	1.4 (0.8, 2.4)	0.23
Receiving food assistance ² (ref: not receiving assistance)	1.9 (1.4, 2.6)	<0.001	1.2 (0.8, 1.9)	0.28
Household refrigeration (ref: no refrigeration)	0.6 (0.4, 1.0)	0.071	1.0 (0.5, 2.1)	0.98
Household running water (ref: no running water)	0.7 (0.5, 1.1)	0.139	1.2 (0.6, 2.3)	0.57

¹ $n = 692$. n may not sum to 692 owing to missing data and percentages may not sum to 100% because of rounding. HNSI, Healthy Navajo Stores Initiative.

²Receiving food assistance defined for this study as participation in the Supplemental Nutrition Assistance Program or the Food Distribution Program on Indian Reservations.

Multivariable logistic regression analysis of shopping behaviors

Multivariable analysis showed that store participation in the HNSI program was strongly associated with customers' purchase of fruits or vegetables. Customers experienced 150% higher odds of purchasing produce if they shopped in HNSI stores, compared with non-HNSI stores ($P < 0.001$) (Table 3), controlling for FVI score, type of store, and other potential covariates. Store type was also significantly associated with customers' purchase of fruits or vegetables. Customers shopping at a grocery store had 520% higher odds of purchasing produce than customers shopping at convenience stores ($P < 0.001$). Customers shopping at trading posts had 120% higher odds of purchasing fruits or vegetables than customers shopping at convenience stores ($P = 0.001$).

Discussion

Our study findings reveal increased healthy purchasing at stores participating in a multifaceted healthy store intervention implemented on a tribal nation. This finding is particularly relevant because it suggests that a multilevel store intervention—offering a suite of strategies to partnering stores including participation in a fruit and vegetable prescription program—may be associated with increased fruit and vegetable purchasing across a variety of store types. The combination of produce

prescriptions along with environmental and promotional strategies may be particularly effective for stores in rural settings, because vouchers may provide monetary incentive and mitigate the risk of stocking increased fresh produce.

Our findings also highlight the importance of food environments for customers' purchasing behaviors in an American Indian reservation. To our knowledge, this is the first study to demonstrate the relation between type of store and the likelihood of produce purchasing in an AI/AN population or a rural setting. This finding is supported by previous research demonstrating that customers shopping in large grocery stores purchase more fruits and vegetables than those shopping in small grocery, specialty, or convenience stores, in an off-reservation urban setting (26). It is possible that trading posts being independently owned allowed them to more easily adopt healthy store interventions (i.e., moving the produce cooler to the front of the store) and respond to customer requests for produce. In addition, trading posts have had long-standing presences in many Navajo communities as sources of dry goods and other traditional food items; customers may be more likely to purchase fruits and vegetables in a store that they already associate with food purchasing than in convenience stores. Although our findings should not exclude convenience stores from participation in future food environment interventions, the importance of store type for customers' healthy purchasing behavior should be considered when designing intervention dosage and delivery.

Associations between individual-level factors, including age, sex, employment, household size, and food assistance, and fruit and vegetable purchasing were in line with expectations. After multivariable analysis, increased shopping frequency was found to be significantly associated with increased fruits or vegetables purchasing, but travel time to the store was not. Our findings are supported by previous research demonstrating that fruit and vegetable consumption is more closely associated with grocery store choice and frequency of shopping trips than with physical distance to a grocery store (27, 28).

More research is needed to fully understand the factors associated with shopping frequency on Navajo Nation so that food access programming can effectively intervene on the most relevant barriers.

Limitations

Our research has several limitations. The study's design resulted in a convenience sampling of customers exiting stores. It is possible that customers who declined to participate had purchasing habits distinct from those of participating customers, introducing a potential for response bias. However, given that only 6.4% of approached customers refused to participate, we feel confident in the validity of our findings. In addition, the survey instrument did not include measures of fruit or vegetable consumption and shopping behavior was based on self-reported purchasing of fruits or vegetables, rather than direct observations or sales data. Although this approach introduces the possibility of participant bias, our methodology is less intrusive and comparable with recent evaluations of other food environment interventions (29–31). We did not formally assess food insecurity, and incorporating a validated instrument in the future would strengthen our understanding of food insecurity among participants. Although these factors limit the scope of our research conclusions, they did contribute to the brevity of the survey, a feature that allowed our study to achieve high participation rates and a large sample size. Lastly, store inventory data were collected at a different time than customer intercept surveys, limiting the conclusions that can be made regarding produce availability and purchasing behaviors.

Conclusions

Our study findings suggest that healthy store interventions in rural Native communities may be associated with increased fruit and vegetable purchasing among local shoppers. However, further evaluation is needed to better understand which HNSI components were more widely adopted and whether certain components had greater or lesser impact on sales and purchasing of healthy foods. In addition, we recognize that healthy store initiatives are just 1 component of what is needed to meaningfully improve food access in tribal communities. Future food environment initiatives in indigenous communities should prioritize strong partnerships with stakeholders across the entire food system, including health policy, environmental justice, and food sovereignty groups working in their respective communities.

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RP-E, and SSS: wrote the paper; OWM and SSS: had primary responsibility for the final content; and all authors: read and approved the final manuscript.

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