ORIGINAL RESEARCH

CURRENT DEVELOPMENTS IN NUTRITION

Food and Nutrition of Indigenous Peoples

# Shopper Purchasing Trends at Small Stores on the Navajo Nation since the Passage of the Healthy Diné Nation Act Tax: A Multi-Year Cross-sectional Survey

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## ABSTRACT

**Background:** In 2014, the Navajo Nation passed the Healthy Diné Nation Act (HDNA), which applies an additional 2% tax on unhealthy foods and beverages and a waiver of Navajo sales tax on healthy foods and beverages. However, the HDNA's impact on purchasing behavior has not been explored.

**Objectives:** We assessed beverage and produce purchasing trends among shoppers at small Navajo stores between 2017 and 2019, shopper characteristics associated with buying water, and whether HDNA awareness was associated with purchasing behaviors.

**Methods:** A total of 332 shoppers at 34 stores in 2017 and 274 shoppers at 44 stores in 2019 were surveyed to assess HDNA awareness and same-day purchasing of water, sugar-sweetened beverages (SSBs), fruits, and vegetables. Hypotheses were tested using chi-square analyses and multivariate analysis.

**Results:** Water purchasing among respondents increased significantly from 2017 to 2019 (24.4% to 32.8%; $P = 0.03$). Shoppers in 2019 were 1.5 times more likely to purchase water compared with 2017 (adjusted $P = 0.01$). There was a trend toward reduced SSB purchasing (85.8% in 2017, 80.3% in 2019, $P = 0.068$), while produce purchasing remained unchanged over time, at approximately 17%. Shoppers were more likely to buy water if they relied on that store for the majority of their groceries ($P = 0.006$) and if they did not have their own transportation to get to the store ($P = 0.004$). Most shoppers (56.6%) were aware of the HDNA; of these, 35.6% attributed healthier habits to the HDNA, most commonly buying more healthy drinks (49.2%), fewer unhealthy drinks (37.7%), more healthy snacks (31.1%), and fewer unhealthy snacks (26.2%).

**Conclusions:** Shopper habits at small stores located on the Navajo Nation have shifted towards healthier purchasing from 2017 to 2019. Shoppers who were aware of the HDNA reported purchasing more healthy and fewer unhealthy food and drinks as a result of this legislation. *Curr Dev Nutr* 2022;6:nzac040.

**Keywords:** water, shopper survey, purchasing behavior, sugar sweetened beverages, junk food tax, Navajo Nation, tribal, food policy, rural



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Abbreviations used: HDNA, Healthy Diné Nation Act; SSB, sugar sweetened beverages.

## Introduction

The Navajo Nation is one of the largest tribal nations in the world, with an enrollment of over 330,000 members (1) and a land base covering over 27,000 square miles across the states of Arizona, New Mexico, and Utah (1, 2). The Navajo (Diné) people traditionally lived a lifestyle characterized by physical activity and consumption of healthy, traditional foods. However, similar to many Indigenous nations (3), the diet of the Navajo people changed with the advent of Western culture and colonization, introducing and increasing the consumption of sugar and foods high in saturated fats (4, 5). A combination of poverty, discriminatory policies, and an underfunded health care system has resulted in disruptions in food systems, high risk for food insecurity (6), and nutrition-related chronic diseases such as type 2 diabetes (7, 8).

The Navajo Nation has been labeled a USDA "food desert" given the limited access to healthy foods (9). While the Navajo Nation roughly covers the size of West Virginia in area, there are only 13 grocery stores throughout (10). Small convenience stores primarily offer processed foods with minimal nutritional value and at higher prices compared with off-reservation stores (11). Navajo store managers have expressed interest in offering healthier options but describe barriers such as variations in perceived customer demand for healthier items and limited fruit and vegetable choices from distributors (12). Meanwhile, focus groups and interviews have shown that Navajo community members are keenly interested in purchasing healthy foods; factors influencing their purchasing habits include proximity to a store, family preferences, ease of preparation, cost, value and quality, shelf-life, freshness, and low availability of healthy foods (13, 14).

In response to these challenges, and to promote the health of the Navajo people, the Navajo Nation Council passed the Healthy Diné Nation Act (HDNA) in 2014, a legislation that included a 2% tax on food of "little-to-no-nutritious value," such as sugar-sweetened beverages (SSBs), chips, cookies, and baked goods (15). An earlier, less well-known part of the HDNA legislation waived the 5% sales tax (currently 6%) on fresh fruits, vegetables, water, nuts, and nut butters. Combined, these taxes represent an 8% difference in pricing of healthy and unhealthy foods. While several global examples exist of unhealthy food taxes, such as in Hungary, Denmark, and Mexico (16–21), and SSB taxes in large US cities (22, 23), this is the first tax to apply both incentives and disincentives in food pricing in the United States or any sovereign tribal nation in the world. Unhealthy food and beverage taxes have typically resulted in reduced consumption of unhealthy foods and increased consumption of water, although most taxes were higher than the HDNA 2% tax, and ranged from 5% to 22% (16–23). Effects were typically greater among low-income groups, but also less pronounced in rural areas (19–21).

At the community level, several interventions have demonstrated the potential to improve the Navajo food environment (24–26). For example, the Healthy Navajo Stores Initiative supports store owners and managers to make changes such as placing produce at the point-of-sale, providing culturally appropriate promotional materials, staff training on produce handling, and reimbursement for produce prescription vouchers for Navajo families with children or mothers at high risk for food insecurity, obesity, or diabetes (25, 26). A prior Navajo shopper survey conducted in 28 grocery and convenience stores on the Navajo Nation found that several factors were associated with produce purchases, including being older, female, shopping at a grocery store (vs. trading post or convenience store), shorter travel time, and receiving food assistance (25).

Despite these forementioned studies, little is known about how purchasing behaviors have changed in response to the HDNA. In addition, despite research documenting the impact of SSB taxes on overall purchasing (16–21), none of this research was conducted in a tribal nation with a population at high risk for diabetes and no research has assessed whether knowledge and perceptions of SSB taxation impact purchasing behaviors at the point-of-sale. To address this knowledge gap, we modified the Navajo shopper survey to include questions about beverage consumption and HDNA awareness. This study describes trends in purchasing behavior among community members shopping at small stores on the Navajo Nation, identifies characteristics associated with healthier beverage purchasing, and explores whether and how the HDNA has influenced purchasing behavior. We hypothesized that, from 2017 to 2019, purchasing trends in water and produce would increase, while SSB trends would decrease. Second, we hypothesized that greater awareness of the HDNA would be associated with healthier purchasing behavior.

## Methods

### Evaluation design

Stores were selected and categorized based on a dataset originally developed in 2013 from a national proprietary set of businesses from InfoUSA on store type, and maintained and supplemented by the research team. Stores were categorized into grocery stores and small stores such as trading posts and convenience stores. A total of 13 grocery stores and 99 small stores were identified on the Navajo Nation.

In cycle 1 (July 2017 to January 2018) and cycle 2 (June to November 2019), we conducted 2 cross-sectional surveys of customers exiting stores on the Navajo Nation. For cycle 1, consecutive shoppers were approached for interview at stores; stores were selected through convenience sampling. The timing of store visits to conduct the surveys was randomized using computer-generated assignment based on 3 variables: weekday/weekend, beginning/end of month, and AM/PM. A minimum of 2 different store visits to intercept customers were made at each store to provide a broader sample of shopping behavior. Sampling methods are described in detail elsewhere (25). In cycle 2, recruitment was modified to maximize the number of participating stores and cover a broader area of the Navajo Nation. All small stores on the Navajo Nation were invited to participate and surveys were collected during a single visit. Given the broad geography and number of stores, it was no longer feasible to randomize the timing of store visits. Instead, visits were scheduled based on the availability of data collectors and distance required to travel, while still taking care to distribute visits across different times of the day, week, and month. In both cycles, survey data were collected using tablets by trained collectors and the team supervisor. Participants were provided with a small incentive (reusable grocery bag, water bottle) upon survey completion. Average survey time was approximately 7 min.

During each store visit, members of the evaluation team approached customers leaving the store. Participant eligibility was assessed before conducting the study and included the following: *1*) were 18 y of age or older, *2*) were not currently pregnant or breastfeeding, *3*) were the primary food shopper in their household, and *4*) lived on the Navajo Nation. Interviews took place outside of the store with consented participants. While information on customers who refused to participate was not collected, customer refusal was minimal and the main reason for refusal was lack of time.

### Measures

The consumer intercept survey was adapted from previous studies (27, 28) for use in a multi-phase, longitudinal evaluation of the Healthy Navajo Store Initiative. The survey instrument was pilot tested at 3 distinct store locations. Feedback regarding word choice, reading level, and cultural competency was incorporated. This survey was first administered in 2016 and has been described in detail elsewhere (25). In 2017, we added questions regarding beverage consumption and awareness

of HDNA. These questions were reviewed by a coalition of stakeholders in the food and healthcare sectors under the CDC-funded REACH program, which is aimed at improving the Navajo Nation food and nutrition infrastructure. The REACH Coalition provides regular feedback on programmatic elements, evaluation priorities and dissemination related to the Navajo Nation food environment (**Supplemental Material 1**).

***Beverage purchasing behavior.***
Customers were asked if they had bought any beverages today at the store. Customers were presented with a list of beverages, including photos, from which to choose. The drink items included regular soda, energy drinks, sports drinks, fruit drinks (not 100% juice), sweetened coffee or tea, and unsweetened water.

***HDNA awareness.***
Participants were also asked if they had heard about the "recent tax changes on the Navajo Nation, which charges an additional 2% tax on 'junk food' and eliminates the 5% Navajo Nation tax on healthy foods." If they were aware of the legislation, they were asked if these recent tax laws have changed what they buy. Respondents who responded yes were further asked if specific changes in their purchasing behavior were influenced by HDNA.

***Demographics.***
The survey also collected sociodemographic information including age, gender, education, and employment status. Household demographic information included size of household, household participation in assistance programs including the Supplemental Nutrition Assistance Program (SNAP) and Food Distribution Program on Indian Reservations (FDPIR), electricity, presence of a reliable refrigerator, presence of a sink with running water, food production, usual mode of transport to the current store, and estimated travel time from home to the current store.

## Analysis

The primary endpoint was healthy beverage purchasing behavior, defined as having purchased water on the day of the survey. Secondary endpoints were same-day purchase of SSBs and the ratio of SSB purchases to water purchases. To evaluate trends over time, we measured the association of survey cycle [baseline (2017) vs. follow-up (2019)] with primary and secondary endpoints. We also assessed the association of HDNA awareness (yes/no) with healthy beverage purchasing behavior, using a bivariate analysis. Sociodemographic and household characteristics included age, gender, education, shopping frequency, mode of transportation to get to the store, whether the store where the survey took place was the shopper's "regular store," household size, electricity, refrigeration, and running water. Missing data were very modest (<1%) and excluded from analysis for the variable in question.

Data analyses were conducted using STATA software version 16.0 (StataCorp LP) (29). Descriptive statistics were used to summarize shoppers' individual- and household-level factors and store characteristics. Bivariate correlation analyses were used to assess correlation between purchasing of water, SSBs, and fruit and vegetables. Chi-square tests (for categorical data) were used to test for differences over time and, using 2019 survey data, comparing shoppers who purchased water and those who did not by individual and household characteristics. For the primary endpoint, we performed a multivariate analysis, retaining covariates associated with the outcome ($P < 0.05$) in a logistic regression model to derive an Odds Ratio (OR) and 95% Confidence Interval (CI) of the association between survey year and water purchasing. A $P$ value of 0.05 was used as the criterion for statistical significance for all analyses. All project procedures were approved by the Navajo Nation Human Research Review Board under protocol NNR-015.199.

## Community participation

A cross-sectoral REACH coalition of stakeholders engaged in health care and food systems were involved in all evaluation efforts. Stakeholders met monthly and provided ongoing feedback regarding evaluation priorities and preliminary findings. Some of these coalition members also participated in data collection, dissemination of findings, and manuscript preparation.

# Results

In total, 606 surveys were collected, with 332 at 34 stores in cycle 1 (2017) and 274 respondents at 44 stores in cycle 2 (2019). Cycle 2 included 25 original stores surveyed as well as 19 additional stores. **Figure 1** shows a graphical representation of all store locations (including both 2017 and 2019 stores) across each of the 5 regional Navajo agencies.

## Demographics and purchasing habits

Among those surveyed, three-quarters of participants were between the ages of 30 and 69 y, 65.5% were female, and 56.3% had a high school education or less. More than half of all participants (52.7%) reported shopping at the store at least weekly. Approximately one-third of households represented by shoppers had 5 or more members, 11% lacked electricity, 11% lacked refrigeration, and 15% did not have running water.

As shown in **Table 1**, several shopper characteristics were associated with healthy beverage purchasing behavior, defined as having purchased water on the day of the survey. Shoppers who bought water were significantly more likely to get a ride, use public transportation, or walk to the store compared with those who did not buy water ($P = 0.006$). Furthermore, people who relied on the survey store for the majority of their groceries were more likely to buy water compared with shoppers who did not consider that store as their "regular" store ($P = 0.004$).

## Correlation of purchasing behaviors

Using 2019 survey data, we identified significant correlations in healthy purchasing patterns. Purchasing water correlated negatively with purchasing SSBs ($r = -0.35$, $P < 0.001$) and correlated positively with purchasing of produce ($r = 0.11$, $P = 0.0085$). On the other hand, SSB and produce purchasing were not correlated ($r = -0.06$, $P = 0.16$).

## Beverage and fruit and vegetable purchasing over time

We evaluated whether purchasing of water, SSBs, and produce changed over time (**Figure 2**). The proportion of shoppers who purchased water significantly increased from 2017 to 2019 (24.4% to 32.8%; $P = 0.02$). As shown in **Table 2**, when controlling for respondent differences over

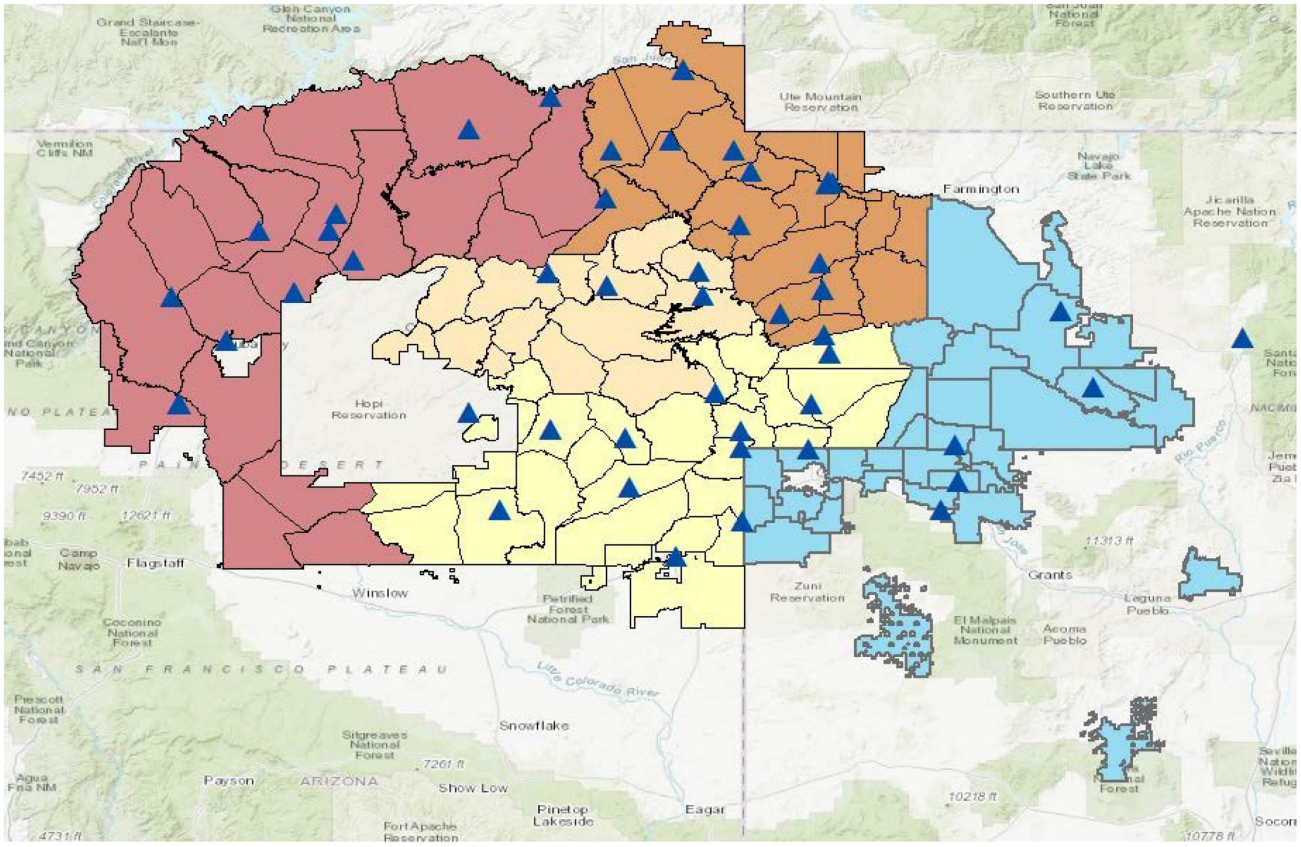


**FIGURE 1** Locations of the stores participating in the shopper intercept surveys on the Navajo Nation in 2017 and 2019. Graphical displays made by authors using ArcMap version 10.7.1 (Environmental Systems Research Institute, Inc (ESRI)) and area map of the Navajo Nation from https://geodata.epa.gov/arcgis/rest/services/Region9/Navajo_Nation_Administrative_Boundaries/MapServer. Colored areas represent each of the 5 regional the Navajo Nation agencies.

time, shoppers were significantly more likely to purchase water in 2019 compared with 2 y prior (adjusted OR: 1.50; 95% CI: 1.04, 2.16). Although the trend in SSB purchasing declined over time, this change was not significant and the proportion of shoppers who bought SSBs remained high (85.8% in 2017 and 80.3% in 2019; $P = 0.068$). In 2017, the purchasing ratio of SSBs to water was 3.5, which decreased to 2.4 in 2019 ($P < 0.001$). Only 1 in 6 shoppers reported purchasing fruits or vegetables on the day of the survey, which was unchanged from 2017 to 2019 ($P = 0.90$).

### HDNA awareness and purchasing patterns

Among all shoppers surveyed from 2017 to 2019, most respondents (343, 56.6%) were aware of the HDNA. HDNA awareness did not change significantly between 2017 and 2019 (58.7% and 54.0%, respectively; $P = 0.24$). Among those familiar with the HDNA, more than one-third (122 shoppers or 35.6%) stated that the HDNA had changed their shopping habits. As shown in **Figure 3**, the types of behavior most commonly influenced by the HDNA were related to changes in beverage purchasing: 49.2% reported buying more healthy drinks and 37.7% reported buying fewer sugary drinks. Other changes included more healthy snacks (31.2%), fewer unhealthy snacks (26.2%), and more healthy foods to prepare at home (29.5%). Interestingly, while the HDNA influenced 10.7% of shoppers to shop more locally, another 15.6% of shoppers reported shopping less locally. On the other hand, HDNA awareness was not significantly associated with specific purchases on the day of the survey, such as water ($P = 0.75$), SSBs ($P = 0.20$), or produce ($P = 0.31$).

## Discussion

This is the first report to assess the impact of a combined "junk food tax" and healthy tax waiver on purchasing behaviors in the United States. From 2017 to 2019, we observed trends toward healthier beverage purchasing at small stores across the Navajo Nation, with significant increases in water purchasing from 24.4% to 32.8% and a nonsignificant decline in SSB purchasing from 85.8% to 80.3%. While pre-HDNA measures in beverage consumption are lacking, we posit that these changes may be attributed to the HDNA, at least in part: approximately half of shoppers who were aware of the HDNA stated that the legislation had influenced them to make healthier beverage choices.

Notably, we found a moderate, but significant inverse correlation between water and SSB purchasing. Nonetheless, SSB purchasing remained approximately 2.5 times more common than water

**TABLE 1** Characteristics associated with water purchasing among shoppers leaving Navajo stores, 2017–2019[1]

| Characteristic (*n* if less than 606) | Bought water (*n* = 171), *n* (%) | Did not buy water (*n* = 435), *n* (%) | *P* |
|---|---|---|---|
| Shopper age (years) | | | 0.40 |
| 18–30 | 29 (17.0%) | 73 (16.8%) | |
| 30–44 | 48 (28.1%) | 109 (25.1%) | |
| 45–69 | 76 (44.4%) | 221 (50.8%) | |
| ≥70 | 11 (6.7%) | 25 (5.8%) | |
| Shopper gender | | | 0.57 |
| Male | 56 (32.8%) | 153 (35.2%) | |
| Female | 115 (67.3%) | 282 (64.8%) | |
| Shopper education, *n* = 596 | | | 0.23 |
| Less than high school | 32 (19.0%) | 84 (19.6%) | |
| High school graduate | 54 (32.1%) | 166 (38.8%) | |
| More than high school | 82 (48.8%) | 178 (41.6%) | |
| Shopping frequency, *n* = 605 | | | 0.54 |
| Twice a week or more | 85 (49.7%) | 204 (47.0%) | |
| Weekly | 31 (18.1%) | 102 (23.5%) | |
| Biweekly to monthly | 41 (24.0%) | 98 (22.6%) | |
| Yearly or other | 14 (8.2%) | 30 (6.9%) | |
| Transportation, *n* = 605 | | | |
| Drive | 142 (83.0%) | 371 (87.5%) | 0.006 |
| Get ride/public transport/other | 23 (13.5%) | 29 (6.68%) | |
| Walk | 6 (3.51%) | 34 (7.83%) | |
| Shopper's use of store | | | |
| Majority of food shopping at this store | 89 (52.1%) | 171 (39.3%) | 0.004 |
| Majority of food shopping at different store | 82 (48.0%) | 264 (60.7%) | |
| Household members | | | 0.89 |
| 1–2 | 56 (32.8%) | 139 (32.0%) | |
| 3–4 | 60 (35.1%) | 147 (33.8%) | |
| ≥5 | 55 (32.2%) | 149 (34.3%) | |
| Electricity, *n* = 604 | | | 0.43 |
| No | 22 (12.9%) | 46 (10.6%) | |
| Yes | 149 (87.1%) | 387 (89.4%) | |
| Refrigeration, *n* = 604 | | | 0.34 |
| No | 22 (12.9%) | 44 (10.2%) | |
| Yes | 149 (87.1%) | 389 (89.8%) | |
| Running water, *n* = 603 | | | 0.78 |
| No | 25 (14.6%) | 67 (15.5%) | |
| Yes | 146 (85.4%) | 365 (84.5%) | |

[1] *n* = 606.

purchasing, although the ratio of purchasing SSBs to water decreased from 3.5 to 2.4 over the 2-y period. These findings are consistent with findings from other settings that have demonstrated healthier purchasing trends resulting from SSB taxes (16–23). For example, in Mexico, following a 1 peso per liter tax, consumption of SSBs decreased between 5.5% and 9.7% compared with time periods before the tax (20, 21, 30, 31) and water consumption increased between 5.2% and 16.2% (21, 30). Similarly, following a $0.01 per ounce SSB tax in Berkeley, California, consumption of SSBs decreased by 21% within a few months (20) and at 3 y, reductions were even greater, with daily SSB consumption decreasing from 1.25 times daily to 0.70 times daily and increased daily water consumption (32). In Cook County, Illinois, following implementation of an SSB tax, the sales volume of taxed beverages decreased by 25.7%, which increased by a similar amount after the tax was repealed (33). However, it has to be noted that some research has documented effects of taxation to be smaller in rural areas (19, 21) and future interventions might benefit from added efforts to shift SSB consumption toward water in these settings.

We found that shoppers were more likely to buy water at the survey store if they relied on the store for the majority of their food and if they were unable to drive themselves to the store, using public transportation, a ride, or walking instead. These findings suggest that an important group of community members rely on these small stores as their primary source for necessities of food and water. This group of shoppers may differ from shoppers who use the store to buy a snack and refreshment; if so, effective strategies to promote healthier purchasing among these subgroups of shoppers would need to differ (e.g., pricing vs. promotion).

More than half of survey respondents were aware of the HDNA legislation, which has included a 2% tax on unhealthy foods and waiver of 5% sales tax on healthy foods. Furthermore, 36% of shoppers familiar with the HDNA acknowledged that the HDNA had changed the way they shopped, with the most common changes related to healthier

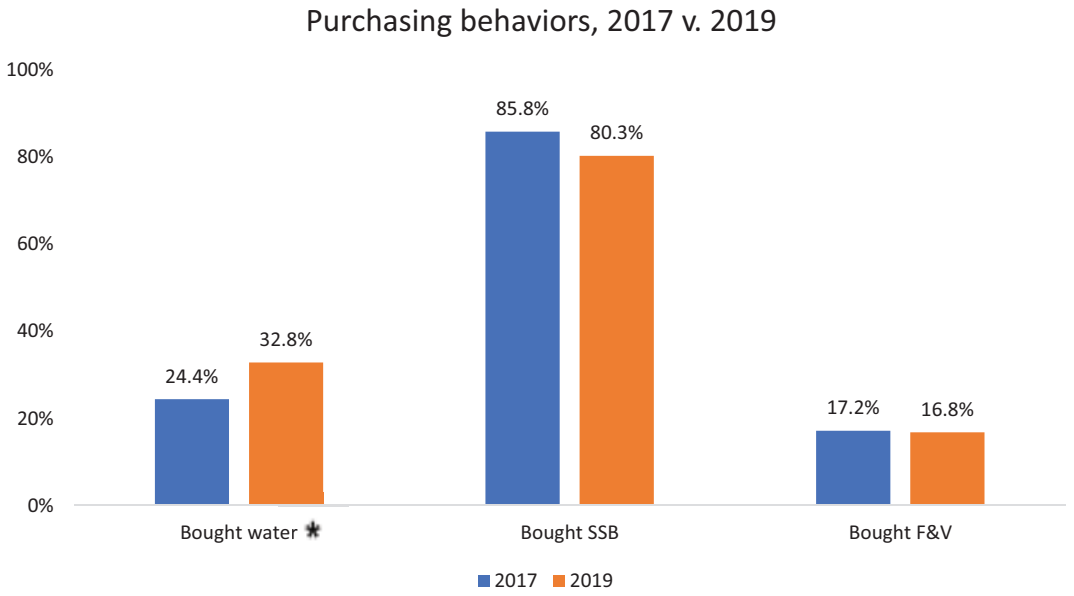


**FIGURE 2** Purchasing of water, SSBs, and fruit and vegetables on the Navajo Nation in 2017 and 2019. *Significantly different between years; $P = 0.02$. F&V, fruit and vegetables; SSB, sugar-sweetened beverage(s).

beverage choices. Although research on the topic is modest, awareness may have an impact on purchasing behaviors and perceptions of barriers (34, 35). For example, in Mexico, a "signaling" effect was found, where people who were aware of the SSB tax were more likely (OR: 1.30) to report a decrease in SSB consumption compared with people who were not aware (34). However, HDNA awareness in the current study was not significantly associated with healthier same-day purchasing behavior. It is possible that the smaller magnitude of the tax or rural setting impacted these findings.

This is the first evaluation to examine the relation between awareness of a unique tribal legislation in the HDNA of 2014 (15) and purchasing habits. An essential element of the HDNA, which was aligned with tribal government structures and local decision making, was that tax revenue from the 2% tax on unhealthy foods was allocated for distribution for wellness projects to each of the 110 local communities on the Navajo Nation. Prior research has documented that each small community (~1650 residents) receives approximately $13,000 annually for wellness projects (36, 37). Thus, the HDNA has the potential to impact people's shopping behavior (through pricing), and also indirectly through health education or awareness because of local community wellness projects funded by the tax. The distribution of the funds directly to small rural communities is unique to the HDNA, although most wellness-related taxes have been connected to some type of health programming. For example, in Hungary, taxes partially fund health care cost (16), whereas Philadelphia's SSB funds pre-kindergarten education, parks, and recreation centers (23), and in Miami-Dade, a half-penny sales tax partially funds the local hospital system (38). Among the shoppers who reported that the HDNA influenced them toward healthier purchasing behavior, it is unknown whether this was impacted by the tax itself, general awareness, or tax-funded local wellness projects. Further research will aim to attain insight into the mechanisms in which the HDNA influences shopping behaviors directly or indirectly.

**TABLE 2** Logistic model predicting odds of purchasing water among shoppers on the Navajo Nation, 2017–2019[1]

| Year | OR | 95% CI | *P* |
|---|---|---|---|
| 2017 | Ref | — | — |
| 2019 | 1.50 | 1.04, 2.17 | 0.01 |

[1] $n = 595$. Model adjusted for covariates that significantly differed in 2017 versus 2019 cohorts, i.e., shopper education, shopping frequency at store, majority of shopping at this store, household size. Ref, reference.

Despite the healthier purchasing trends and the possible influence of the HDNA on healthier habits, substantial barriers remain in the Navajo Nation to accessing healthy foods and beverages. The large land area combined with poverty and small number of grocery stores continue to make accessing healthy foods challenging and the risk of food insecurity high (9, 10). In the current evaluation, we found that 10–15% of shoppers did not have electricity, running water, or refrigeration. Engagement with store managers to improve the food store environment and increase access using multifaceted approaches has previously shown success (24, 25). In addition, prior research has emphasized the importance of engagement with store managers and aligning public health outcomes with retailers' business models (39). A successful example is the Navajo Fruit and Vegetable Prescription (FVRx) Program, where health care workers prescribe vouchers to high-risk families, which the families can redeem at the stores, which, in turn, are reimbursed (26). This program has been successful in terms of increasing fruit and vegetable consumption and reducing food insecurity and child body mass index.

### Limitations

The sample was a convenience sample based on customers exiting stores, and the sampling approach changed by necessity between cycles

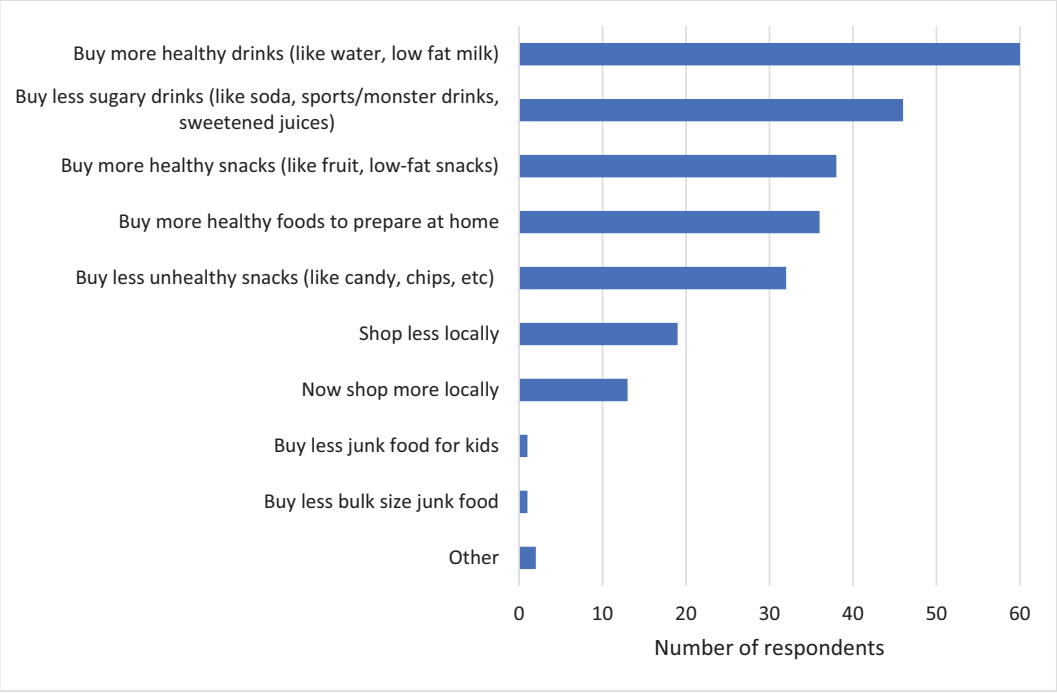


**FIGURE 3** Influences of the HDNA on purchasing behavior among shoppers aware of HDNA, 2017–2019; $n = 122$. HDNA, Healthy Diné Nation Act.

1 and 2 to broaden the number of stores. To assess the impact of a larger number of stores in cycle 2, we further conducted sensitivity analyses restricted to the 25 stores that were surveyed in both years. The findings among the subsample of the 25 stores were highly similar to the overall sample, with an 8% increase in water purchasing from 2017 to 2019, a 10% decrease in SSB purchasing, and significant decrease in the ratio of water to SSB purchases. These analyses provide further justification for including all stores in the final analytic cohort. Since participation was voluntary, it is possible that consumers who declined participation may be different from the customers who participated. However, the proportion of people who declined participation was modest in both years (~6%). Furthermore, the survey was based on self-reported purchasing, rather than direct observations or receipts. Although this introduces possible bias, this methodology was less intrusive and similar to other research on interventions aimed at impacting the food environment (40–42). In addition, we did not assess in-depth factors such as food insecurity or accuracy of people's understanding of the HDNA legislation, nor were we able to survey a comparison group. Additionally, we were not able to capture a pre-HDNA measurement. In terms of strengths, our survey was based on prior research, and captured a broad range of demographics, purchasing behaviors, and HDNA perceptions in a large cohort. Finally, participation was high and the survey's brevity very likely contributed to high participation rates.

## Conclusions

This report describes same-day purchasing patterns and trends on the Navajo Nation, a large sovereign tribal nation in the United States, since the first-ever tax on junk foods was passed in 2014. Significantly healthier beverage purchasing patterns were observed in 2019 compared with 2017, and more than one-third of shoppers who were aware of the HDNA legislation attributed healthier shopping habits to the legislation, particularly related to beverages. Future research should continue to track purchasing behaviors over time and assess whether trends towards healthier purchasing continue. In addition, research should aim to gain greater insight into direct and indirect impacts of the HDNA legislation and mechanisms of their influence on health behaviors.

## Acknowledgments

The authors' responsibilities were as follows—CG, SSS, ATL, and CC: designed the research; CG, CB, TE, AR, KT, SS, and SKS: conducted the research; ATL, HdH, and CC: analyzed data or performed statistical analysis; ATL, CG, CB, HdH, CAC, DY, and SSS: wrote and edited the manuscript; SSS: had responsibility for final content; and all authors: read and approved the final manuscript.

## Data Availability

The data for this manuscript are under ownership of the Navajo Nation and cannot be shared publicly without permission of the Navajo Nation. For further information, contact the Navajo Nation Human Research Review Board, Navajo Department of Health, P.O. Box 1390, Window Rock, AZ 86515; phone: 928-697-2525.

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