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Food Distribution Research Society

Journal of Food Distribution Research
Volume 53, Issue 2

Table of Contents

Food Distribution Research Society

Journal of Food Distribution Research
Volume 53, Issue 2, pp. 1–25

Factors Affecting Consumer Purchasing Decisions and Willingness to Pay for Oysters in South Carolina

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Abstract

South Carolina oyster producers are looking to expand into other sales channels and need more marketing data to support their efforts. A survey in the South Carolina marketing area (n = 1210) indicates that South Carolina oyster consumers tend to be younger, Caucasian, live in coastal counties, have higher household incomes, and prefer eating oysters at restaurants. Consumers willing to pay higher prices for oysters to eat at home tend to be younger, female, have higher household incomes, and are not Caucasian. Availability, price, and food safety concerns were the top three reasons preventing consumers from buying more oysters at restaurants.

Keywords: oysters, marketing, consumer preferences, willingness-to-pay

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Introduction

According to the U.S. Census of Aquaculture, South Carolina has increased its production of Eastern oysters [1] by more than 250% between 2013 and 2018 (USDA, 2019). This growth continued after 2018, with a recent study indicating an 84% increase through 2019 (South Carolina Sea Grant Consortium, 2021). This increase was mostly due to the adoption of new oyster farming technology—floating cages—which keep oysters in ideal water temperature, salinity, and nutrient content (Holleman, 2018).

South Carolina producers sell more than 90% of their oysters to restaurants, and in typical years there is more demand than supply (Richards, 2020a). However, 2020 was not a typical year. A seismic shock happened when COVID-19 restrictions shut down restaurants, causing South Carolina oyster producers to lose their market overnight (Richards, 2020b; Richards, 2020c; Richards, 2020d). Compounding this problem, South Carolina oyster producers could not quickly pivot from restaurant sales to other marketing outlets. Some producers found limited success with online sales but not enough to cover the cost of operations.

This situation made South Carolina oyster producers realize that they need to diversify their sales channels to mitigate future marketing risk. Because oyster producers sell directly to restaurant buyers, they cannot easily observe retail customer traits. More marketing research is necessary to help oyster producers better understand customer preferences and attract new customers. In addition, collecting data from those who do not eat oysters is essential to determine if any barriers to consumption can be mitigated with different marketing efforts.

Studies for all types of seafood have been conducted both within and outside the United States. Many of these studies focus on seafood labeling: eco-labeling and sustainability certification (Xu et al., 2012; Fonner and Sylvia, 2015; Lim et al., 2015; Carlucci et al., 2017; Brayden et al., 2018; Zander and Feucht, 2018; Hilger et al., 2019; Vitale et al., 2020), food safety claims (Lin and Milon, 1993; Wessels and Anderson, 1995; Shikuku et al., 2020), and seafood source information (Harper, 2015; Nguyen et al., 2015; Dissanayake and Chen, 2016; McClenachan, Dissanayake, and Chen, 2016; van Houcke et al., 2018; Soley, Hu, and Vassalos, 2019). Other studies seek to discover consumer preferences for seafood (Thong and Solgaard, 2017; Kim et al., 2020) and shellfish, including oysters (Batzios et al., 2003; Debucquet et al., 2012; van Houcke et al., 2018).

U.S. oyster consumer surveys have gauged consumer preferences and willingness to pay for oyster branding (Petrolia, Walton, and Yehouenou, 2017), farmed versus wild-harvested (Manalo and Gempesaw, 1997; Kecinski et al., 2017), local versus non-local (Chen et al., 2017; Li, Kecinski, and Messer, 2017; Li, Ahsanuzzaman, and Messer, 2020), and raw versus cooked or processed oysters (Bruner et al., 2014; Li, Kecinski, and Messer, 2017). Some of these studies evaluated where consumers preferred to buy oysters (Love et al., 2020; Bouchard et al., 2021), if they consumed oysters at home or away from home (Herrmann et al., 1994; Zhang et al., 2004; Love et al., 2020), and their reasons for not consuming or not consuming more oysters (Lin and Milon,

[1] *Crassostrea virginica*, Atlantic oyster, American oyster, or Atlantic cupped oyster. An oyster that is native to eastern North America.

1993; House, Hanson, and Sureshwaran, 2003; Zhang et al., 2004). However, to the best of our knowledge, there have been no studies focusing specifically on the southeastern United States.

The southeastern region of the United States is of particular interest because it consistently ranks high in oyster consumption in national surveys (Cheng and Capps, 1998; House, Hanson, and Sureshwaran, 2003; Zhang et al., 2004; Li, Kecinski, and Messer, 2017). One food writer even called the Southeast the "Napa Valley of Oysters" (Niemark, 2016). Despite this fact, there have been no oyster consumer preference studies specific to South Carolina consumers. While South Carolina consumers were undoubtedly included in some of the previously mentioned national surveys (House, Hanson, and Sureshwaran, 2003; Zhang et al., 2004), these studies did not separate single, premium oyster consumption from wild, cluster oyster consumption. Nor was there any need to do this 18 years ago because single-oyster aquaculture production in South Carolina was inconsequential at that time (2005 U.S. Census of Aquaculture) (USDA-NASS, 2006).

South Carolina Oyster Consumer Preference Survey

The data for the study were obtained from an online survey of residents living in the local oyster marketing areas of coastal South Carolina and the zip codes in the metro areas of Greenville, Spartanburg, Charleston, Columbia, and Myrtle Beach. Zip codes from Savannah, Georgia, and Charlotte, North Carolina, were also included, as these metro areas border South Carolina. One reason for choosing this sample area was that urbanization is positively associated with seafood purchasing decisions (Herrmann et al., 1994; Yen and Huang, 1996; Cheng and Capps, 1998; Kow et al., 2008). Qualtrics distributed the survey in August 2020. A total number of 1,210 complete responses were received, consisting of 905 oyster consumers (74.8%) and 305 non-consumers (25.2%).

South Carolina oyster producers and South Carolina Sea Grant Consortium personnel reviewed and pretested the survey instrument. The questionnaire included a set of screening questions that asked if the survey respondent was over 18 years of age, if they live in one of the targeted zip codes, if they are a primary household food purchasing decision maker,[2] and if they consume single on-the-half-shell oysters (versus the wild-harvested cluster oysters). Also, photographs of single, on-the-half-shell oysters were shown alongside pictures of wild-harvested cluster oysters to avoid confusion between the two. Survey questions relating to locally grown oysters included oysters that were cultivated in South Carolina, North Carolina, and Georgia.

Survey Sample Demographics

Table 1 compares the survey sample demographics with those of South Carolina and the United States as a whole. The survey respondents were younger, more likely to be female, and had higher educational attainment than the United States and South Carolina populations. Survey participants have a slightly higher than average household income for South Carolina but a slightly lower household income than the U.S. average. Respondent household size tended to be a bit larger than the United States as a whole or South Carolina. Non-Caucasians (Black/African American and

[2] The person(s) who controls the household budget and decides prioritization of regular household expenditures.

other ethnicities) are represented at a higher rate than found in the United States as a whole, but are a close match to the ethnic demographics of South Carolina.

Table 1. Demographics of Sample versus U.S. and South Carolina Populations

	Sample	**U.S.**	**S.C.**
Age			
18 to 25 years of age	15.3%	1.5%	1.4%
26 to 34 years of age	28.3%	6.9%	5.7%
35 to 54 years of age	35.7%	29.6%	29.6%
55 to 64 years of age	10.9%	28.1%	27.4%
65 years and older	9.8%	33.9%	35.9%
Gender			
Male	31.2%	49.5%	51.5%
Female	68.8%	50.5%	48.5%
Highest level of education completed			
High school or less	19%	37.3%	43.5%
Some college or associate's degree	36%	27.0%	30.1%
Bachelor's degree	29%	9.8%	16.9%
Advanced degree	16%	3.3%	9.5%
Household income (self reported)			
Less than $29,999	21.1%	21.1%	32.4%
$30,000 to $49,999	22.4%	16.0%	20.3%
$50,000 to $74,999	21.7%	16.5%	18.2%
$75,000 to $99,999	13.8%	12.3%	11.5%
$100,000 to $149,999	12.9%	15.5%	11.0%
$150,000 or greater	8.1%	18.5%	6.7%
Size of household			
Only me	15.2%	28.2%	34.3%
Two people	32.2%	34.8%	34.4%
Three people	22.1%	15.1%	13.3%
Four people	17.9%	12.7%	10.2%
Five or more people	12.5%	9.3%	7.8%
Race			
White/Caucasian	67.5%	76.5%	68.5%
Black/African American	27.3%	13.4%	27.1%
Other Race	5.2%	10.1%	4.4%

The high female response rate is most likely due to the screening question limiting the survey to those that make household food purchasing decisions. This phenomenon is not uncommon for online survey samples (Smith, 2008; Mulder and de Bruijne, 2019). Respondents who are younger and have higher educational attainment are often included in surveys. Access to the internet may or may not be an issue, with 82.9% of South Carolinians having internet access (U.S. Census Bureau, 2019). However, younger people and those with higher educational attainment tend to

have higher internet speeds and use the internet more frequently (Bethlehem, 2010), likely contributing to the observed differences.

Oyster consumers tended to be Caucasian, possess a higher level of educational attainment, have higher household income, and live in coastal counties. Oyster consumers differed by age, with more non-consumers in the 35–65 age range and more oyster consumers in the 18–34 range. Table 2 compares the demographics of oyster consumer respondents with non-consumer respondents with the results of a Welch's *t-test* on the means of each demographic category. Results are consistent with previous studies, indicating that seafood consumers tend to be younger, with higher income and higher education (Lin and Milon, 1993; Wessels and Anderson, 1995; Cheng and Capps, 1998; Batzios et al., 2003; House, Hanson, and Sureshwaran, 2003; Zhang et al., 2004; Harper, 2015; van Houcke et al., 2018; Quagrainie, 2019; Li, Ahsanuzzaman, and Messer, 2020). Gender and household size did not appear to have significant differences between the means.

Table 2. Demographics of Oyster Consumers (n = 905) and Non-Consumers (n = 305)

	Consume (Yes)	**Consume (No)**	***t*-test**
Age			
18 to 25 years of age	15.5%	14.8%	
26 to 34 years of age	31.0%	20.3%	
35 to 54 years of age	35.2%	37.0%	***
55 to 64 years of age	10.1%	13.4%	
65 years and older	8.2%	14.4%	
Gender			
Male	32.0%	28.5%	
Female	68.0%	71.5%	NS
Highest level of education completed			
High school or less	17.3%	23.6%	
Some college or associate's degree	35.8%	37.4%	***
Bachelor's degree	29.6%	27.5%	
Advanced degree	17.2%	11.5%	
Household income (self reported)			
Less than $29,999	18.0%	30.2%	
$30,000 to $49,999	23.3%	19.7%	
$50,000 to $74,999	20.7%	24.9%	***
$75,000 to $99,999	14.1%	12.8%	
$100,000 to $149,999	14.9%	6.9%	
$150,000 or greater	9.0%	5.6%	
Size of household			
Only me	15.1%	15.4%	
Two people	32.2%	32.5%	
Three people	21.0%	25.6%	NS
Four people	19.3%	13.8%	
Five or more people	12.4%	12.8%	

Table 2. (cont)

	Consume (Yes)	Consume (No)	*t*-test
Race			
White/Caucasian	69.8%	60.7%	***
Non-Caucasian	30.2%	39.3%	
Coastal versus inland			
Coastal residency	50.3%	40.3%	***
Inland residency	49.7%	59.7%	

Note: Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels.

Results

How Consumers Eat Oysters

Considering that the previous literature provides limited information on how consumers prefer their oysters prepared, the survey participants who consume oysters indicated their preference for oyster preparation (raw, steamed, grilled, or in a recipe combined with other ingredients). The respondents had the option to select all methods applying to their tastes. Figure 1 shows that steamed is the most popular preparation method (70.9%), followed by grilled (48.4%), raw (41.9%), and cooked in a recipe with other ingredients (33.4%).

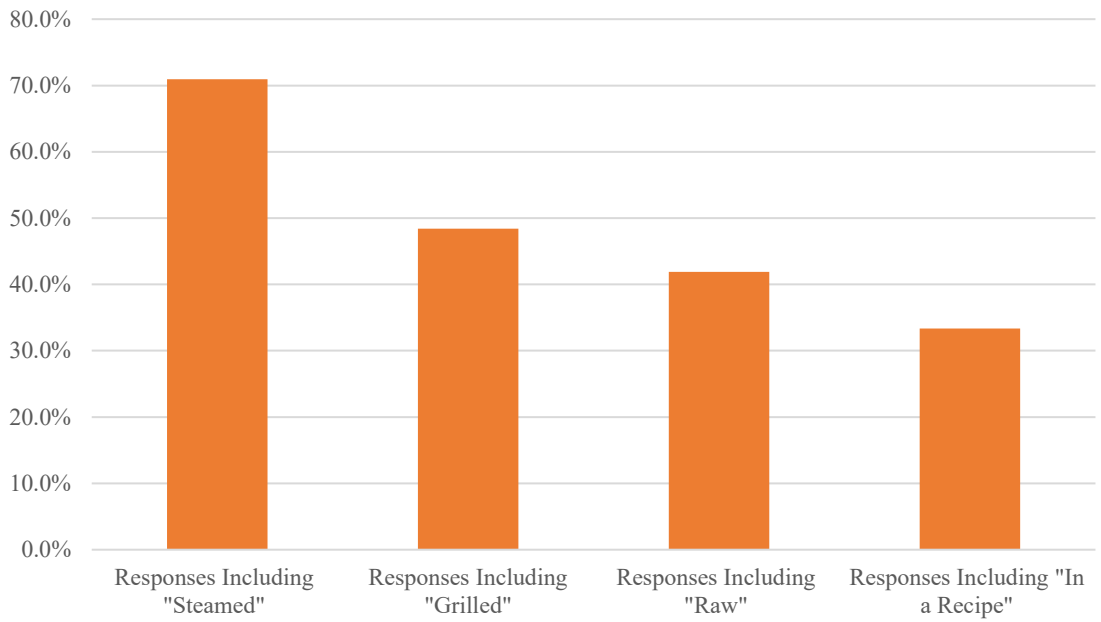

Figure 1. A Summary of All Responses to Preferred Oyster Preparation Methods

Respondents who consume raw oysters were asked further questions about what percentage of their oyster consumption is raw and whether oyster food safety was a concern. This group indicated that they consumed oysters raw 60.2% of the time. By multiplying the incidence of raw consumption (41.9%) by the percent these consumers eat their oysters raw (60.2%), we estimate the size of the raw market to be about 25% of the total local oyster market. In terms of food safety,

more than 73% of raw oyster consumers were either not concerned or only slightly concerned about food safety.

Where Consumers Eat Oysters

For South Carolina oyster producers, it is essential to estimate the sales potential of the at-home market. Survey respondents answered a multiple-response question about where they ate oysters: at home, at a restaurant, or at an oyster roast. Restaurants are the most common locations for eating oysters (74.7%), followed by home (44.5%) and roasts (40.6%). Roast responses are interesting because roasts could potentially occur at home or in a restaurant. An estimate of the size of the home market was reached by questioning at-home oyster consumers (44.5% of respondents) about the percent of oysters they ate at home. The average response was 54.2%, indicating an estimated at-home market size of about 24% (54.2% x 44.5%). This result is precisely the midpoint of the range cited in previous literature (Zhang et al., 2004; Richards, 2020a). To further evaluate the likelihood of home consumption, survey participants responding that they did not eat oysters at home (n = 502, or 55.5%) were asked an additional question: would they consider purchasing oysters to eat at home. Most of these respondents (91%) were willing to consider purchasing oysters to eat at home (65% "Yes" and 26% "Maybe" responses). This response may suggest that the at-home market has the potential to increase from 36% (65% x 55.5%) to 50% (91% x 55.5%) of the away-from-home consumers (see Table 3).

Table 3. Where Consumers Eat Oysters

	Percent
Where consumed (N = 905)	
Home only	15.4%
Restaurant only	32.9%
Oyster roast only	7.3%
Home and restaurant	11.2%
Home and oyster roast	2.7%
Home, restaurant, and oyster roast	15.4%
Restaurants and oyster roasts	15.2%
Responses including "home"	44.5%
Responses including "restaurants"	74.7%
Responses including "roasts"	40.6%
% consumed at home (if "home" checked)	54.2%
Home responses x percent consumed at home	24.1%
Percent of oysters consumed away from home	75.9%
Would you consider purchasing oysters for home? (n = 502)	
Yes	64.5%
Maybe	26.3%
No	9.2%

Willingness to Pay for Oysters at Restaurants and Home

Consumers who eat oysters at restaurants (n = 676) were asked about their willingness to pay for local,[3] high-quality oysters at a restaurant. Likewise, those who responded that they purchased oysters to eat at home (n = 403) were asked about their willingness to pay for local, high-quality oysters to eat at home. Survey participants were presented with a categorical series of possible prices ranging from $0.49 to more than $3.00 per oyster for home and restaurant consumption. Figure 2 summarizes the amounts oyster consumers are willing to pay for local, high-quality oysters. The most frequent response (mode) was $1.49 to $1.99 per oyster at a restaurant and $1.00 to $1.49 per oyster to eat at home.

Figure 2. Willingness to Pay for Oysters at Restaurants and Home

Purchasing Barriers at Restaurants, for Home Consumption, and Non-Consumers

One of the main objectives of this study was to discover ways for South Carolina producers to sell more oysters. All oyster consumers (n = 905) were asked what obstacles or barriers prevented them from purchasing more oysters. The top two reasons (both 48% of respondents) were the availability of fresh oysters and price. Concern about food safety was the third most common reason (28.8%). Other reasons included restaurants not preparing oysters in the manner the customer prefers, having the ability to try oysters from across the United States (instead of eating only local oysters), and preferring not to purchase oysters in a restaurant (see Figure 3). Those who responded that they did not buy oysters to eat at home were combined with those who stated they would not consider buying them to eat at home (n = 83). For this subset of consumers, the dislike of shucking (50.6%), a lack of preparation knowledge (40.7%), and food safety concerns (39.8%) were the top

[3] Survey participants were informed that "locally grown" included oysters cultivated in South Carolina, North Carolina, or Georgia.

three reasons. Interestingly, price was nearly the last reason for why these customers did not buy oysters to eat at home (see Figure 4), which highlights the severity of the previously aforementioned barriers and relative uniqueness of shellfish preparation.

Figure 5 shows the responses from 822 consumers who already purchase oysters to eat at home or are willing to consider purchasing oysters to eat at home. These customers were asked about what would encourage them to buy additional oysters to eat at home. Like the restaurant consumer responses, availability (63.3%) and price (50.6%) were the top two reasons, followed by desiring oysters that are pre-shucked (38.4%), having more information on oyster preparation (26.6%), and having the oysters pre-cooked (20%).

The 305 survey respondents who did not eat oysters were asked why they did not consume oysters, whether they were willing to try oysters, and what would encourage them to try eating oysters.

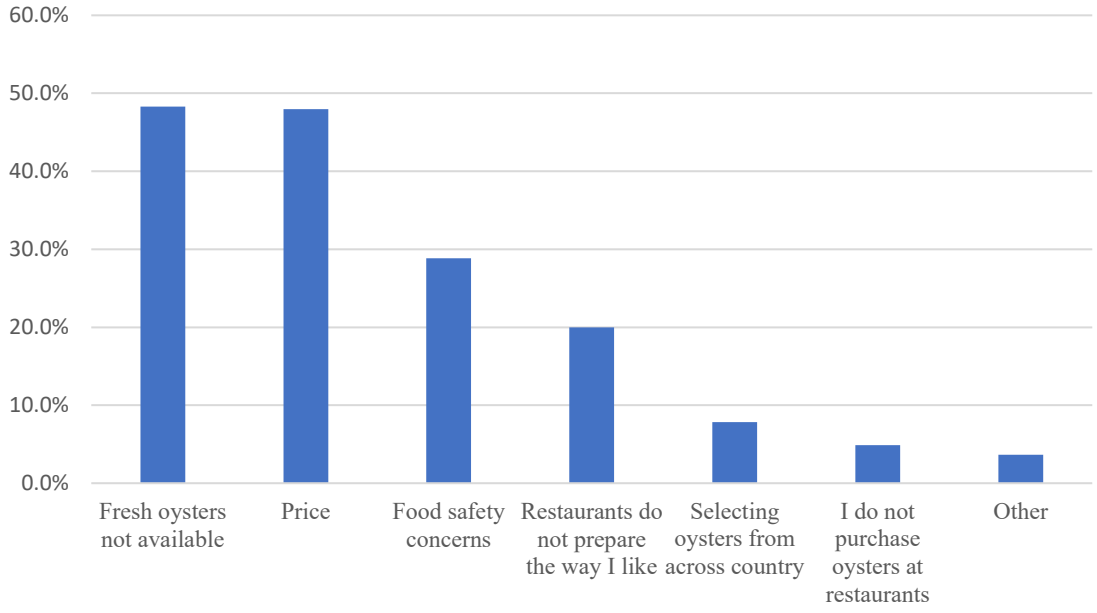

Figure 3. Barriers to Purchasing Oysters at Restaurants

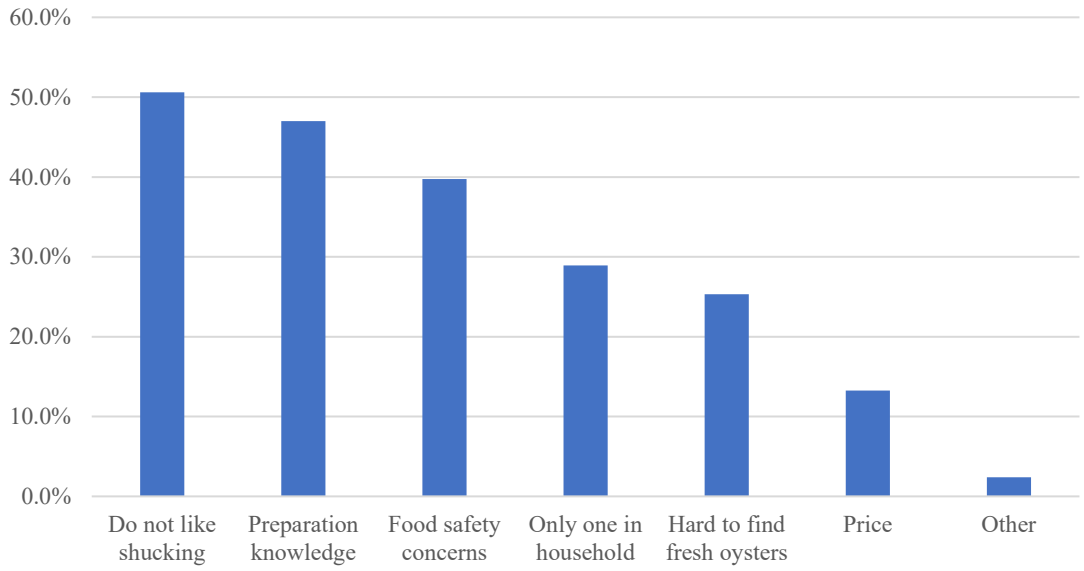

Figure 4. Barriers to Purchasing Oysters to Eat at Home

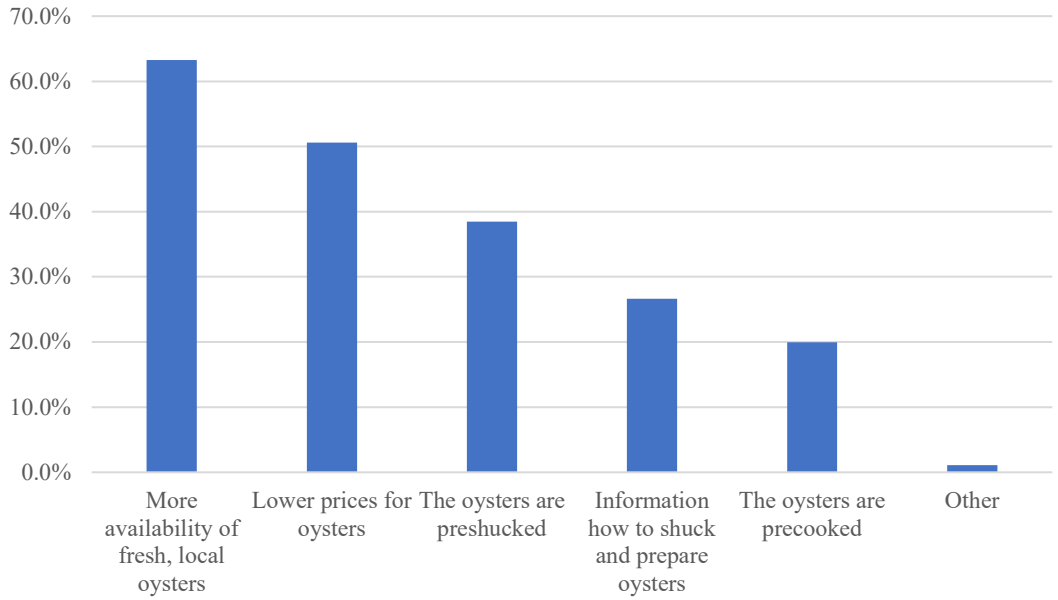

Figure 5. Answers to What Would Encourage More Home Purchases

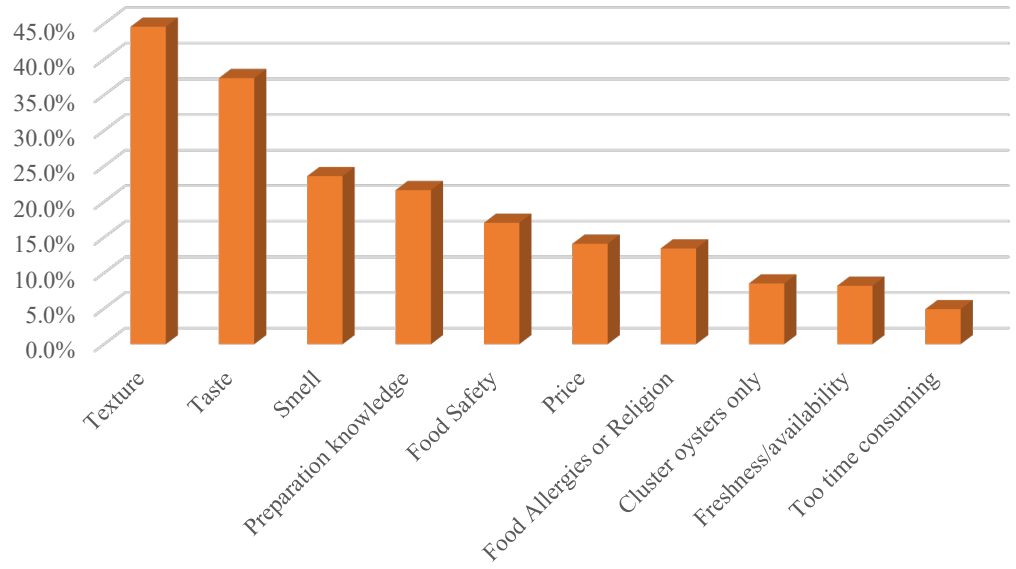

Figure 6. Oyster Non-Consumer Reasons for Not Eating Oysters

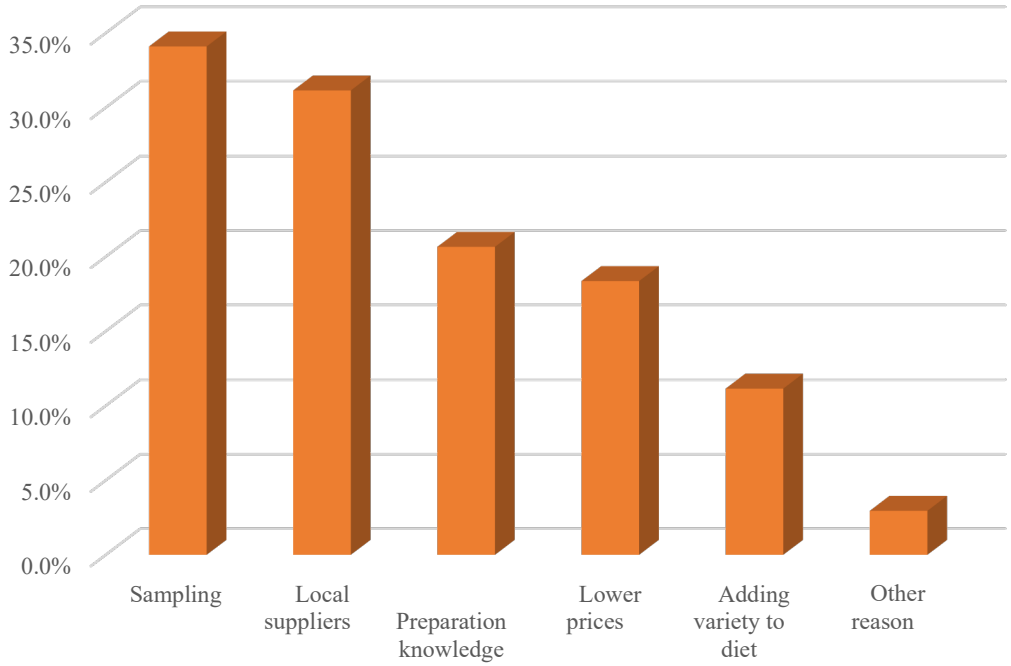

Figure 7. What Would Encourage Non-Consumer to Try Oysters

The reasons for not consuming oysters were texture, taste, smell, a lack of preparation knowledge, food safety concerns, price, allergies, or religion, preferring cluster oysters, freshness and availability, and being too time-consuming to prepare (see Figure 6). In response to whether they would be willing to try eating oysters, 61.3% replied "Yes" or "Maybe." Those willing to try

oysters believed that sampling oysters, having local suppliers, increased preparation knowledge, lower prices, and adding variety to their diets would encourage them to eat oysters (see Figure 7).

Oyster Attributes and Buying Preferences

Consumers who purchase oysters to eat at home (n = 403) were asked to rank important attributes when buying oysters, with "1" being the highest importance and "5" being the lowest importance. The responses ranked, in order, are freshness, size, appearance, cost, and knowing where the oyster was raised. Also, these same consumers were asked about where they preferred to buy oysters. Their preferences (in order) are farmers' markets, seafood markets, grocery stores, buying directly from the farm, ordering online, and having the oysters shipped to their homes.

As a follow-up question to buying location preferences, consumers were asked if they had a seafood market in their area. Two-thirds of consumers had a seafood market in their area (66.5%). Those that did not have a local seafood market (33.4%) were asked if they would purchase more oysters if a seafood market did exist, and 93.8% replied that they would purchase more oysters. The additional number of oysters these consumers expected to purchase was between 2 to 3 times as much (54.7% and 21.7% of respondents, respectively). Customers were also asked about their willingness to drive (in terms of miles) to purchase oysters. Almost one-third were willing to drive 10 miles, and almost 50% were willing to drive up to 20 miles (see Table 4).

Table 4. Assessing the Importance of a Seafood Market (n = 822)

	Frequency	**Percent**
Do you have a public seafood market in your location?		
Yes	547	66.5%
No	275	33.5%
Would You Buy More Oysters if a Market Existed? (n = 275)		
Yes	258	93.8%
No	17	6.2%
How many more oysters would you buy? (n = 258)		
More than four times as many	23	8.9%
Four times as many	21	8.1%
Three times as many	56	21.7%
Twice as much	141	54.7%
No additional oysters	17	6.6%
How far are you willing to drive? (n = 822)		
Less than 10 miles	265	32.2%
Between 10 and 20 miles	403	49.0%
Between 20 and 30 miles	112	13.6%
More than 30 miles	42	5.1%

Analysis and Models Used

Binomial Logit Regression: Oyster Consumption

Respondents were asked if they consume oysters (Y = 1) or do not consume oysters (Y = 0). Logistic regression is used to find the probability that a survey respondent will consume oysters (Pr(Y = 1)). The general form of the logistic model is shown below. Logistic regression is also used to find the probability that a survey respondent consumes raw oysters.

$$\Pr(Y = 1) = 1 / (1 + \exp[-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_7 X_7)]) \quad (1)$$

$\Pr(Y = 1)$ = The probability of consuming oysters

X_i = Independent variables (7 demographic and personal characteristics)

β_i = Coefficients of the model, each representing parameters of the model

Ordered Logit Regression: Ranked Responses

Oyster consumers were asked questions about their willingness to pay for oysters to eat at home and in restaurants. Consumers who ate raw oysters were asked what percent of oysters they consumed raw versus cooked. The above response variables are good examples of ranked responses, better analyzed using an ordered logit regression model. For example, suppose Y represents an ordering of responses. In that case, a larger value of Y represents more raw consumption or the willingness to pay higher prices to eat at home and in a restaurant. A general form of the ordered logit model is:

$$\Pr(Y_i = j) = \Pr(\mu_{j-1} < Y_i \leq \mu_j) = \Pr(\mu_{j-1} < [\beta_0 + \beta_i X_i + \varepsilon_i] \leq \mu_j) \quad (2)$$

Y_i = Predicted ranking (consumption frequency or willing to pay higher prices)

μ_j = μ is the categorical threshold, with j representing the ranking or cut point

X_i = Independent variables (7 demographic and personal characteristics)

β_i = Coefficients of the model, each representing parameters of the model

ε_i = Random error term

In the analysis, the dependent variable for willingness to pay, WTP^*, is used to model the sequence of the 6 levels of the observed variable WTP separated by 5 cut points, as shown below. In the model, a set of coefficients ($\mu_1 < \mu_2 \ldots < \mu_{j-1}$) with ($j$-1) intercept terms as cut points in the distribution of the willingness to pay choices, representing the threshold values from moving from one category of WTP to another, higher category.

$$WTP_i^* = j \text{ if } \mu_{j-1} < WTP_i^* \leq \mu_j \quad (3)$$

For example, the willingness to pay dependent variable has 6 ordered choices separated by 5 cut points, as shown below. Therefore, the ordered logit regression (Green, 2012) is used to estimate the probability that WTP_i^* lies in one threshold or another. Table 5 summarizes both the dependent and independent variables for these models.

$$
\begin{aligned}
&WTP_i = 1 \text{ (\$0.50 to \$0.99) if } WTP_i^* \le \mu_1 \\
&WTP_i = 2 \text{ (\$1.00 to \$1.49) if } \mu_1 < WTP_i^* \le \mu_2 \\
&WTP_i = 3 \text{ (\$1.50 to \$1.99) if } \mu_2 < WTP_i^* \le \mu_3 \\
&WTP_i = 4 \text{ (\$2.00 to \$2.49) if } \mu_3 < WTP_i^* \le \mu_4 \\
&WTP_i = 5 \text{ (\$2.50 to \$2.99) if } \mu_4 < WTP_i^* \le \mu_5 \\
&WTP_i = 6 \text{ (\$3.00 and over) if } \mu_5 < WTP_i^* \le \mu_6
\end{aligned}
\tag{4}
$$

Logistic Regression Results

Logistic regression investigated factors affecting the probability of oyster consumption and raw oyster consumption (see Table 6). Regression coefficients for consuming oysters show that Age, Ethnicity, Household Income, and living near the coast significantly affect the probability of oyster consumption. Marginal effects suggest that an increase in age decreases the probability of consuming oysters by 4.9%; an increase in household income increases the probability of consuming oysters by 3.9%; being Caucasian increases the probability of consuming oysters by 7%, and living on the coast increases the probability of consuming oysters by 8.7%.

Table 5. Description of Variables in the Logistic and Ordinal Regression Models

Variable	Description	Response Categories
Age	Age	(1) under 25, (2) 25 to 34, (3) 35 to 44, (4) 45 to 54, (5) 55 to 64, (6) 65 to 74, and (7) 75 years or older
Female	Gender	(1) female and (0) male
Caucasian	Race or ethnicity	(1) white/Caucasian, (0) not white/Caucasian
Education	Educational attainment	(1) high school or less, (2) some college, (3) bachelor's degree, and (4) advanced degree
HHIncome	Household income	(1) Less than $29,999, (2) $30,000 to $49,999, (3) $50,000 to $74,999, (4) $75,000 to $99,999, (5) $100,000 to $149,999, and (6) $150,000 and greater
HHSize	Household size	(1) only me, (2) 2 people, (3) 3 people, (4) 4 people, and (5) 5 or more people
Coast	Lives on the coast	(1) live in coastal county and (0) does not live in a coastal county
WTPHome	Willingness to pay to eat oysters at home	Per oyster: (1) $0.50 to $.99, (2) $1.00 to $1.49, (3) $1.50 to $1.99, (4) $2.00 to $2.49, (5) $2.50 to $2.99, and (6) over $3.00
WTPRest	Willingness to pay to eat oysters at restaurant	Per Oyster: (1) $0.50 to $.99, (2) $1.00 to $1.49, (3) $1.50 to $1.99, (4) $2.00 to $2.49, (5) $2.50 to $2.99, and (6) over $3.00
Consume	Oyster consumer	(1) consumer eats oysters and (0) consumer does not eat oysters.
Raw	Raw oyster consumer	(1) consumer eats raw oysters and (0) consumer does not eat raw oysters.

Table 6. Logistic Regression: Consuming Oysters and Consuming Raw Oysters

	Consuming Oysters			Consuming Raw Oysters		
Coefficients	**Value**	**Std. Error**	**Marginal Effects**	**Value**	**Std. Error**	**Marginal Effects**
Female	-0.05	-0.15	-0.009	-0.02	-0.15	-0.004
Age	-0.27 ***	-0.05	-0.049	0.10 *	-0.05	0.024
Caucasian	0.38 *	-0.15	0.070	0.59 ***	-0.16	0.134
Education	0.1	-0.08	0.018	0.24 **	-0.08	0.054
HHSize	-0.05	-0.06	-0.009	-0.07	-0.06	-0.015
HHIncome	0.22 ***	-0.05	0.039	0.11 *	-0.05	0.024
Coast	0.49 ***	-0.14	0.087	0.1	-0.14	0.023
(Intercept)	0.85 *	-0.4		-1.83 ***	-0.42	
N	1210				905	
AIC	1309.85				1184.31	
BIC	1350.63				1222.77	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Regression coefficients for consuming raw oysters show that Age, Ethnicity, Education, and Household Income have a significant effect on raw oyster consumption. Marginal effects suggest that increase in age increases the probability of consuming raw oysters increases by 2.4%; increase in education level increases the probability of consuming raw oysters by 5.4%; increase in household income increases the probability of consuming raw oysters by 2.4%: and being Caucasian increases the probability of consuming raw oysters by 13.4%.

Ordered Logit Regression Results

Ordered logit regression was used to estimate the factors that influence consumers' willingness to pay higher prices. Table 7 shows ordinal regression coefficients concerning willingness to pay for oysters at home and restaurants. Age, Gender (female), Household Income, and Ethnicity (non-Caucasian) are significant variables influencing consumers' willingness to pay for oysters to eat at home. Significant variables associated with willingness to pay at restaurants are Gender (female), Age, and Household Income.

Ordered logit regression was also performed on respondents' stated frequency for consuming raw oysters and consuming oysters at home. Significant variables associated with a higher frequency of raw consumption are Age, Household Income, and Ethnicity (Caucasian). Significant variables associated with a higher frequency of home consumption are Gender (male), Age, Ethnicity (non-Caucasian), and living in a non-coastal location.

Table 7. Willingness to Pay at Home and Restaurants, Raw Oyster Consumption Frequency, and Home Consumption Frequency

	WTP: At Home (n = 403			**WTP: Restaurants (n = 676)**			**Raw Consumption Frequency (n = 379)**			**Home Consumption Frequency (n = 403)**		
Coefficients	**Value/SE**	***t*-value**	***p*-value**	**Value/SE**	**t-value**	***p*-value**	**Value/SE**	***t*-value**	***p*-value**	**Value**	***t*-value**	***p*-value**
Female	0.409	2.13	0.033*	0.2620	1.72	0.085'	-0.1902	-0.96	0.339	-0.5014	-2.58	0.01*
	(0.192)			(0.152)			(0.190)			(.0.195)		
Age	-0.171	-2.65	.008**	-0.2039	-4.13	.000***	-0.1143	-1.72	0.085'	0.1605	2.47	0.013*
	(0.065)			(0.049)			(0.068)			(0.065)		
HHIncome	0.119	1.77	0.076'	0.1833	3.52	.000***	0.2489	3.65	.000***	0.0473	0.69	0.487
	(0.067)			(0.052)			(0.249)			(0.068)		
HHSize	-0.068	-0.93	0.353	0.0070	0.12	0.903	-0.0489	-0.64	0.524	0.0329	0.45	0.650
	(0.074)			(0.058)			(0.049)			(0.073)		
Caucasian	-0.439	-2.20	.028*	-0.0513	-0.31	0.757	0.8510	3.57	.000***	-0.3869	-1.97	0.048*
	(0.200)			(0.166)			(0.851)			(0.196)		
Education	0.163	1.56	0.118	0.0795	0.98	0.326	-0.1756	-1.58	0.115	-0.0957	-0.92	0.356
	(0.104)			(0.081)			(0.176)			(0.104)		
Coast	-0.262	-1.41	0.157	-0.1166	-0.82	0.410	-0.0963	-0.50	0.616	-0.4165	-2.24	0.025*
	(0.185)			(0.142)			(0.096)			(0.186)		
Intercepts:												
	Value	**Std. Error**	***t*-value**	**Value**	**Std. Error**	***t*-value**	**Value**	**Std. Error**	***t*-value**	**Value**	**Std. Error**	***t*- value**
1|2	-1.0845	0.5031	-2.1559	-1.4820	0.4188	-3.5391	-2.3391	0.5916	-3.9536	-2.7408	0.5106	-5.3672
2|3	0.1514	0.4995	0.3032	-0.0762	0.4141	-0.1839	-1.0084	0.5737	-1.7577	-1.5071	0.4977	-3.0282
3|4	1.0490	0.5028	2.0860	1.0585	0.4164	2.5417	0.1564	0.5702	0.2743	-0.5247	0.4924	-1.0656
4|5	1.9131	0.5108	3.7450	2.2437	0.4228	5.3073	0.9219	0.5723	1.6109	0.3395	0.4918	0.6904
5|6	2.5095	0.5202	4.8239	3.0162	0.4324	6.9749						
	Residual Deviance: 1336.305 AIC: 1360.305			Residual Deviance: 2249.001 AIC: 2273.001			Residual Deviance: 1118.12 AIC: 1140.12			Residual Deviance: 1260.338 AIC: 1282.338		

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ' $p < 0.1$

Marketing Implications

Logistic regression results indicate that oyster consumers, in general, tend to be younger, live in a coastal county, are likely to be White/Caucasian, and have higher household incomes. Age tending to be younger is encouraging, as it indicates the consumer base has potential to grow, considering millennials (those 24–39 years of age in 2020) are America's largest generation (Fry, 2020). Coastal county residency may be significant due to proximity, allowing for greater availability and product freshness (the top-ranked attribute in the survey for purchasing oysters).

The raw oyster market commands the highest premium in South Carolina. This seems to be the case elsewhere in the United States (Botta et al., 2021) and may be the most valued way of marketing oysters overall (Petrolia, Walton, and Yehouenou, 2017; Kamiyama and Takahashi, 2019). Variables associated with raw oyster consumption are somewhat different from those of the general oyster consumer, suggesting that raw oyster consumers tend to be older, are White/Caucasian, have higher household incomes, and have higher educational attainment. Raw consumption associated with older age groups may be partially explained by a high number of younger individuals (18–25 years) reporting that they did not eat raw oysters. Still, there appear to be more instances of older individuals reporting that they eat raw oysters in the dataset. European studies of oyster consumption explain that eating them raw is a traditional method (Debucquet et al., 2012; van Houcke et al., 2018). House et al. (2003) found that U.S. oyster consumers tended to be older as well. However, the most likely explanation may be found in the analysis of raw oyster consumption frequency. Ordered logit regression results found that those who eat raw oysters more frequently tend to be younger, have higher household income, and are Caucasian (see Table 7), consistent with other age-related oyster consumer traits in this study.

Food safety does not appear to be a concern for raw oyster consumers in this study. In contrast, general oyster consumers cited food safety as the third most common barrier to purchasing more oysters at restaurants and at home. However, consumer sentiment changes about food safety and raw consumption, especially during oyster recalls (Dowell et al., 1995; Shieh et al., 2007; McIntyre et al., 2012). Oyster producers dependent on selling their oysters solely for raw consumption would be wise to have alternative marketing channels or post-harvest oyster processing technology available. Oyster producers may also be well served by promoting their growing methods, which have been shown to produce safer oysters (Canty et al., 2020).

Consumer willingness to pay for oysters generated some noteworthy results. The willingness to pay question was posed to respondents as the maximum they would be willing to pay per oyster at home and restaurants. When considering this fact, it appears that a sizeable portion of restaurant consumers may have indicated they are not willing to pay market prices for locally raised oysters, which are priced between $2.00 and $3.50 on most South Carolina restaurant menus (Richards, 2020a). These findings are not specific to South Carolina either, as a recent restaurant menu meta-study reports that average menu prices for oysters in the United States also fall within this range, with the Southeast commanding the lowest average menu price (Botta et al., 2021). This study suggests that willingness-to-pay results are generally applicable to the southeastern United States but may not be applicable to other parts of the United States with respect to oyster prices. On a

positive note, for those who buy oysters to eat at home, most respondents are willing to pay current South Carolina local oyster prices, which are in the range of $1.00 to $1.49 each (Richards, 2020a).

Ordered logit regression indicated a higher willingness to pay for oysters to eat at home and was accompanied by a likelihood that the consumer is younger, female, has higher household income, and is not Caucasian. Consumers who had a higher willingness to pay for oysters at restaurants were more likely to be female, younger, and have a higher household income. These findings reinforce observations in the literature that the restaurant consumer may have different traits or attributes than the home consumer (Herrmann et al., 1994; House, Hanson, and Sureshwaran, 2003). Heterogeneity of oyster consumers is not a new finding, either. For example, a study in Delaware (Li, Kecinski, and Messer, 2017) found that fried oyster consumers differed considerably from those consuming oysters prepared in other manners. Discovering which preparation methods are preferred for home consumption would be a good topic for future study.

While the at-home market is a small piece of the total oyster market (24%), the lessons of COVID-19 and restaurant shutdowns underline the importance of understanding this group of oyster consumers and potentially increasing the at-home oyster market. The survey results show that at least 65% of those who do not eat oysters at home are willing to try it. Factors encouraging these consumers to buy oysters to eat at home include increased availability, lower prices, pre-shucked oysters, and more preparation knowledge. Price and availability concerns were less important factors for those unwilling to consider purchasing oysters to eat at home, with a dislike of shucking, a lack of preparation knowledge, and food safety concerns being more critical barriers.

The three most preferred attributes when buying oysters are freshness, size, and appearance. Interestingly, the cost of the oysters and where they were cultivated ranked fourth and fifth. One explanation for cost appearing lower in this ranking (versus price in other questions in the survey) may be that freshness, market size, and acceptable appearance are prerequisites to the purchasing decision before price is considered. Where the oysters were raised ranking last disagrees with some of the local food literature. This result may have been encouraged because respondents already considered the oysters to be local based on other questions in the survey. However, there have been studies that show that a generic “local” label may generate a higher willingness-to-pay response than seafood products labeled with a precise location (McClenachan, Dissanayake, and Chen, 2016; Li, Ahsanuzzaman, and Messer, 2020). These findings may encourage collaborative marketing efforts among local producers, where promotional efforts can focus on local origins versus producer and site-specific origins.

Preferences for where to buy oysters showed that farmers’ markets were first, followed by seafood markets and grocery stores. Buying at the farm and ordering online were the least preferred options, which may disappoint producers desiring to sell directly to the consumer. It appears that more seafood buying points might be a better strategy, with most survey respondents replying that they would buy 2 to 3 times more oysters if a seafood market existed in their area. Furthermore, as respondents point out, they would like these buying points to be close by, less than 20 miles away. As an extension of this research, ArcGIS mapping of zip codes collected from survey respondents will be used to identify potential locations for seafood buying points in South Carolina.

Finally, this study aimed to assess what marketing efforts might encourage non-consumers to eat oysters. Respondents' top reasons for not eating oysters were taste, texture, smell, a lack of preparation knowledge, and food safety concerns. These reasons are like those found in House et al.'s study (2003), where the authors pondered whether trying to reach non-consumers was worth the effort. To answer this question, non-consumers in this study were asked if they would be willing to try oysters and what would encourage them to do so. Sampling, local suppliers, and increased preparation knowledge were the top three responses. Oyster sampling may be a way to gain new consumers, and it has been observed that local suppliers encourage non-consumers to try seafood (Richard and Pivarnik, 2020). It may also be worthwhile to encourage younger people (in the 18–25 age range) to sample raw oysters to build that market for the future.

Conclusions and Limitations

South Carolina has substantially increased its oyster production over the past decade. Despite these productivity gains, South Carolina oyster producers have limited knowledge about the characteristics of oyster consumers. This study is an effort to cover this gap in the literature. To the best of our knowledge, this is the first study that addresses oyster consumers and non-consumers, their demographic traits, consumption patterns, and willingness to pay in the South Carolina marketing area.

Limitations to this research include capturing other methods of oyster preparation and actual oyster consumption volume. This study focused exclusively on single, premium oyster preparations and did not determine the total number of oysters each demographic group consumed. Other limitations of the survey included separating the barriers to consumption or purchases based on prior responses and consumption locations, limiting data modeling options. Future research could focus on these topics and questions related to expanding oyster marketing efforts to non-Caucasians, inland consumers, and retailers other than restaurants. Additional research concerning oyster attributes, both pre-purchase and post-purchase, would also provide beneficial information for oyster marketing.

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References

Batzios, C.H., P. Angelidis, D.K. Moutopoulos, C.H. Anastasiadou, and V. Chrisopolitou. 2003. "Consumer Attitude towards Shellfish in the Greek Market: A Pilot Study." *Mediterranean Marine Science* 4(2).

Bethlehem, J. 2010. "Selection Bias in Web Surveys." *International Statistical Review* 78(2).

Botta, R., T. Garlock, J. Anderson, and F. Asche. 2021. "An Analysis of US Restaurant Menus to Determine the Importance of Product Attributes for Farmed Oysters." Paper presented at the annual meeting of Aquaculture America, San Antonio, TX, August 11–14.

Bouchard, D., M.E. Camire, C. Davis, G. Shaler, R. Dumont, R. Bernier, and R. Labbe. 2021. "Attitudes toward Aquaculture and Seafood Purchasing Preferences: Evidence from a Consumer Survey of Atlantic States." *Aquaculture Economics and Management*.

Brayden, W.C., C.L. Noblet, K.S. Evans, and L. Rickard. 2018. "Consumer Preferences for Seafood Attributes of Wild-Harvested and Farm-Raised Products." *Aquaculture Economics and Management* 22(3).

Bruner, D.M., W.L. Huth, D.M. McEvoy, and O.A. Morgan. 2014. "Consumer Valuation of Food Safety: The Case of Post-Harvest Processed Oysters." *Agricultural and Resource Economics Review* 43(2).

Canty, R., D. Blackwood, R. Noble, and B. Froelich. 2020. "A Comparison between Farmed Oysters Using Floating Cages and Oysters Grown On-bottom Reveals More Potentially Human Pathogenic Vibrio in the On-bottom Oysters." *Environmental Microbiology* 22(10).

Carlucci, D., B. de Devitiis, G. Nardone, and F.G. Santeramo. 2017. "Certification Labels versus Convenience Formats: What Drives the Market in Aquaculture Products?" *Marine Resource Economics* 32(3).

Chen, J.Q., M.C. Haws, Q.S.W. Fong, and P.S. Leung. 2017. "Locally Grown Oysters in Hawai'i: Chef Preference and Local Premium?" *Journal of the World Aquaculture Society* 48(6).

Cheng, H., and O. Capps. 1988. "Demand Analysis of Fresh and Frozen Finfish and Shellfish in the United States." *American Journal of Agricultural Economics* 70(3).

Debucquet, G., J. Cornet, I. Adam, and M. Cardinal. 2012. "Perception of Oyster-Based Products by French Consumers. The Effect of Processing and Role of Social Representations." *Appetite* 59(3).

Dowell, S.F., C. Groves, K.B. Kirkland, H.G. Cicirello, T. Ando, Q. Jin, J.R. Gentsch, S.S. Monroe, C.D. Humphrey, C. Slemp, D.M. Dwyer, R.A. Meriwether, and R.I. Glass. 1995. "A Multistate Outbreak of Oyster-Associated Gastroenteritis: Implications for Interstate Tracing of Contaminated Shellfish." *Journal of Infectious Diseases* 171(6).

Drammeh, L., L. House, S. Sureshwaran, and H. Selassie. 2002. "Analysis of Factors Influencing the Frequency of Catfish Consumption in the United States." Selected paper for the American Agricultural Economics Association Meeting, Long Beach, CA, July 30–August 3.

Fonner, R., and G. Sylvia. 2015. "Willingness to Pay for Multiple Seafood Labels in a Niche Market." *Marine Resource Economics* 30(1).

Fry, R. (2020). *Millennials Overtake Baby Boomers as America's Largest Generation.* Pew Research Center. Available online: https://www.pewresearch.org/fact-tank/2020/04/28/millennials-overtake-baby-boomers-as-americas-largest-generation/.

Greene, W.H. 2012. *Econometric Analysis*, 7th ed. Upper Saddle River, NJ: Prentice Hall.

Harper, J.W. 2015. "The New Man and the Sea: Climate Change Perceptions and Sustainable Seafood Preferences of Florida Reef Anglers." *Journal of Marine Science and Engineering* 3(2):299–328.

Herrmann, R.O., G.P. Rauniyar, G.D. Hanson, and G. Wang. 1994. "Identifying Frequent Seafood Purchasers in the Northeastern US." *Agricultural and Resource Economics Review* 23(2).

Hilger, J., E. Hallstein, A.W. Stevens, and S.B. Villas-Boas. 2019. "Measuring Willingness to Pay for Environmental Attributes in Seafood." *Environmental and Resource Economics* 73(1).

Holleman, J. 2018. "Tank to Table." *Coastal Heritage* 31(2):3–12. Available online: https://www.scseagrant.org/wp-content/uploads/2018-CH-Summer-Web.pdf.

House, L., T.R. Hanson, and S. Sureshwaran. 2003. "US Consumers: Examining the Decision to Consume Oysters and the Decision of How Frequently to Consume Oysters." *Journal of Shellfish Research* 22(1):52–59.

Kamiyama, R., and H. Takahashi. 2019. "Evaluation of Shelled Oysters from Miyagi Prefecture Destined for Raw Consumption by Japanese Consumers Intending to Cook." *Nippon Suisan Gakkaishi (Japanese Edition)* 85(1).

Kecinski, M., K.D. Messer, L. Knapp, and Y. Shirazi. 2017. "Consumer Preferences for Oyster Attributes: Field Experiments on Brand, Locality, and Growing Method." *Agricultural and Resource Economics Review* 46(2).

Kim, K.-B., J.-H. Moon, W.-S. Lee, and K.-S. Ko. 2020. "A Study on Tourism Resources Using Local Specialties: The Determinants of Willingness to Pay for Jeju Seafood." *Journal of Tourism Sciences* 44(7).

Kow, F., L. Yu, D. Fitzgerald, and D. Grewal. 2008. "Understanding the Factors Related to the Consumer's Choices of Oysters in Australia: An Empirical Study." *Journal of Foodservice* 19(4).

Li, T., Ahsanuzzaman, and K.D. Messer. 2020. "Is this Food 'Local'? Evidence from a Framed Field Experiment." *Journal of Agricultural and Resource Economics* 45(2).

Li, T., M. Kecinski, and K.D. Messer. 2017. "Heterogeneous Preferences for Oysters: Evidence from Field Experiments." *Agricultural and Resource Economics Review* 46(2).

Lim, K.H., C. Grebitus, W. Hu, and R. Nayga Jr. 2015. "More than Meets the Eye: Consumers' Willingness to Pay for Marine Stewardship Council's Certified Seafood." *Agricultural and Applied Economics Association and Western Agriculture Economics Association* 37209(479).

Lin, C.-T Jordan, and J.W. Milon. 1993. "Attribute and Safety Perceptions in a Double-Hurdle Model of Shellfish Consumption." *American Journal of Agricultural Economics* 75(3).

Love, D.C., F. Asche, Z. Conrad, R. Young, J. Harding, E.M. Nussbaumer, A.L. Thorne-Lyman, and R. Neff. 2020. "Food Sources and Expenditures for Seafood in the United States." *Nutrients* 12(6).

Manalo, A.B., and C.M. Gempesaw. 1997. "Preferences for Oyster Attributes by Consumers in the U.S. Northeast." *Journal of Food Distribution Research* 28(2).

McIntyre, L., E. Galanis, K. Mattison, O. Mykytczuk, E. Buenaventura, J. Wong, N. Prystajecky, M. Ritson, J. Stone, D. Moreau, and A. Youssef. 2012. "Multiple Clusters of Norovirus among Shellfish Consumers Linked to Symptomatic Oyster Harvesters." *Journal of Food Protection* 75(9).

McClenachan, L., S.T.M. Dissanayake, and X. Chen. 2016. "Fair Trade Fish: Consumer Support for Broader Seafood Sustainability." *Fish and Fisheries* 17(3).

Motallebi, M., and G. Gaines. 2021. *Mariculture in South Carolina*. Charleston, SC: South Caroline Sea Grant Consortium. Available online: https://www.scseagrant.org/wp-content/uploads/Economic-Contribution-of-Oyster-Mariculture-SC.pdf.

Mulder, J., and M. de Bruijne. 2019. "Willingness of Online Respondents to Participate in Alternative Modes of Data Collection." *Survey Practice* 12(1):1–11.

Nguyen, T.T., W. Haider, H.S. Solgaard, L. Ravn-Jonsen, and E. Roth. 2015. "Consumer Willingness to Pay for Quality Attributes of Fresh Seafood: A Labeled Latent Class Model." *Food Quality and Preference* 41.

Neimark, J. 2016. *Why the Southeast Could become the Napa Valley of Oysters*. Available online: https://www.npr.org/sections/thesalt/2016/01/27/462929374/why-the-southeast-could-become-the-napa-valley-of-oysters.

Petrolia, D.R., W.C. Walton, and L. Yehouenou. 2017. "Is There a Market for Branded Gulf of Mexico Oysters?" *Journal of Agricultural and Applied Economics* 49(1).

Quagrainie, K.K. 2019. "Consumer Willingness to Pay for a Saline Fish Species Grown in the US Midwest: The Case of Striped Bass, Morone saxatilis." *Journal of the World Aquaculture Society* 50(1).

Richard, N., and L. Pivarnik. 2020. "Rhode Island Branding Program for Local Seafood: Consumer Perceptions, Awareness, and Willingness-to-Pay." *Journal of Agriculture, Food Systems, and Community Development* 9(2).

Richards, S. 2020a. *Feasibility Study: Lowcountry Oyster Production.* South Carolina Business Level Feasibility Study (Unpublished Report; On File with USDA Rural Development). Clemson University. Copy in possession of the first author.

Richards, S. 2020b. *Impacts of COVID-19 Restaurant Closures on South Carolina's Shellfish Industry.* Clemson, SC: Clemson University, Extension Publication LGP 1070. Available online: https://lgpress.clemson.edu/publication/impacts-of-covid-19-restaurant-closures-on-south-carolinas-shellfish-industry/.

Richards, S. 2020c. *The South Carolina Shellfish Industry Faces a Challenging Recovery After COVID-19*. Clemson, SC: Clemson University, Extension Publication LGP 1071. Available online: https://lgpress.clemson.edu/publication/the-south-carolina-shellfish-industry-faces-a-challenging-recovery-after-covid-19.

Richards, S. 2020d. *The Post COVID-19 Restaurant Recovery May Take a While.* Clemson, SC: Clemson University, Extension Publication LGP 1068. Available online: https://lgpress.clemson.edu/publication/the-post-covid-19-restaurant-recovery-may-take-a-while/.

Shieh, Y.C., Y.E. Khudyakov, G. Xia, L.M. Ganova-Raeva, F.M. Khambaty, J.W. Woods, J.E. Veazey, M.L. Motes, M.B. Glatzer, S.R. Bialek, and A.E. Fiore. 2007. "Molecular Confirmation of Oyster as the Vector for Hepatitis in a 2005 Multistate Outbreak." *Journal of Food Protection* 70(1).

Shikuku, K.M., N. Tran, L. Pincus, V. Hoffmann, C.J. Lagerkvist, S.L. Akintola, K.A. Fakoya, and J. Muliro. 2020. "Experimental and Survey-based Data on Willingness to Pay for Seafood Safety and Environmental Sustainability Certification in Nigeria." *Science Direct* 30.

Smith, W.D. 2008. *Does Gender Influence Online Survey Participation? A Record-linkage Analysis of University Faculty Online Survey Response Behavior.* San Jose, CA: San Jose State University. Retrieved from ERIC database. (ED5017-17). Available online: https://files.eric.ed.gov/fulltext/ED501717.pdf.

Soley, G., W. Hu, and M. Vassalos. 2019. "Willingness to Pay for Shrimp with Homegrown by Heroes, Community-Supported Fishery, Best Aquaculture Practices, or Local Attributes." *Journal of Agricultural and Applied Economics* 51(4).

Thong, N.T., and H.S. Solgaard. 2017. "Consumer's Food Motives and Seafood Consumption." *Food Quality and Preference* 56.

U.S. Census Bureau. 2019. *Geography Profile: South Carolina*. Available online: https://data.census.gov/cedsci/profile?g=0400000US45.

U.S. Department of Agriculture. 2019. *Census of Aquaculture (2017)*. Volume 3, Special Studies Part 2. AC-17-SS-2. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service.

U.S. Department of Agriculture. 2006. *Census of Aquaculture (2005).* Volume 3, Special Studies Part 2. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service.

U.S. Department of Agriculture. 2021. *Food Availability (Per Capita) Data System. Meat, Poultry, Fish, Eggs, and Nuts Dataset.* Available online: https://www.ers.usda.gov/data-products/food-availability-per-capita-data-system/ [Accessed July 12, 2021].

van Houcke, J., T. Altintzoglou, J. Linssen, and J. Luten. 2018. "Quality Perception, Purchase Intention, and the Impact of Information on the Evaluation of Refined Pacific Cupped Oysters (Crassostrea gigas) by Dutch Consumers." *Journal of the Science of Food and Agriculture* 98(12).

Vitale, S., F. Biondo, C. Giosuè, G. Bono, C.O.R. Okpala, I. Piazza, M. Sprovieri, and V. Pipitone. 2020. "Consumers' Perception and Willingness to Pay for Eco-Labeled Seafood in Italian Hypermarkets." *Sustainability (Switzerland)* 12(4).

Wessells, C., and J. Anderson. 1995. "Consumer Willingness to Pay for Seafood Safety Assurances." *Journal of Consumer Affairs* 29(1).

Xu, P., Y. Zeng, Q. Fong, T. Lone, and Y. Liu. 2012. "Chinese Consumers' Willingness to Pay for Green- and Eco-Labeled Seafood." *Food Control* 28(1).

Yen, S.T., and C.L. Huang. 1996. "Household Demand for Finfish: A Generalized Double-Hurdle Model." *Journal of Agricultural and Resource Economics* 21(2).

Zander, K., and Y. Feucht. 2018. "Consumers' Willingness to Pay for Sustainable Seafood Made in Europe." *Journal of International Food and Agribusiness Marketing* 30(3).

Zhang, X., L. House, S. Sureshwaran, and T.R. Hanson. 2004. "At-Home and Away-from-Home Consumption of Seafood in the United States." Selected paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Tulsa, Oklahoma, February 18, 2004.

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Consumer Attitudes and Consumption Patterns for Pecans and Other Tree Nuts: Beyond a Simple Shell Game

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Abstract

This study provides insights into consumer beliefs, awareness, attitudes, and purchasing behavior regarding tree nuts in general and pecans specifically. Findings from a probit regression suggest factors associated with the decision to purchase pecans were age, region, sources of information about tree nuts, and outlets where tree nuts are purchased. Respondents aged 45 and over were more likely to purchase pecans than younger respondents. Conventional media (radio, television, magazines), past experience, and recipes significantly impact the decision to purchase pecans. Tree nut purchases from grocery stores, supercenters, roadside stands, or farmers' markets were positively related to pecan purchases.

Keywords: consumer survey, tree nuts, pecans, probit regression

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Introduction

Federal Marketing Agreement and Order (FMO) No. 986 (7 CFR part 986) established the American Pecan Council (APC) in August 2016 to represent growers and shellers from 15 states, namely Alabama, Arkansas, Arizona, California, Florida, Georgia, Kansas, Louisiana, Missouri, Mississippi, North Carolina, New Mexico, Oklahoma, South Carolina, and Texas (Pecans Grown in the States of Alabama, et al.; Order Regulating Handling, 2016). The FMO authorizes the APC to collect data, conduct research and promotion activities, and regulate the grade, size, quality, pack, and containers for pecans. Under the Order, the U.S. pecan industry is developing a coordinated program designed to strengthen its position in the marketplace. U.S. tree nut stakeholders, particularly those involved with almonds, hazelnuts, pistachios, walnuts, and pecans, have capitalized on nutritional aspects by incorporating health messages about their products in promotional campaigns (Lillywhite, Simonsen, and Heerema, 2014). As such, the growth in the domestic demand for pecans, as well almonds, walnuts, and pistachios, has been buoyed in part by their promotion as nutritious and healthy snacks by marketing boards and trade associations.

The health benefits of nut products have been widely documented. Evidence exists to substantiate the claim that nut consumption reduces the incidence of coronary heart disease, gallstones, diabetes, hypertension, cancer, and inflammation (Fraser et al., 1992; Blomhoff et al., 2006; Kris-Etherton et al., 2008; Ros, 2010) and decreases body mass index (BMI) (King et al., 2008; Mattes, Kris-Etherton, and Foster, 2008). In the latest *Dietary Guidelines for Americans 2020-2025*, nuts are included in the spectrum of nutrient-dense foods and proteins (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020), further highlighting their importance in improving the health and nutrition status of consumers. Participants in the Special Supplemental Nutrition Program for Women, Infants, and Children in North Carolina consumed nuts because they were thought to be healthy (Pawlak, Colby, and Herring, 2009).

Out of domestically produced tree nuts, the dominant tree nuts in terms of per capita consumption are almonds, pecans, walnuts, and pistachios. Based on the most recent data (2020/21 season) from the United States Department of Agriculture Economic Research Service (USDA-ERS), per capita consumption of almonds, pecans, walnuts, and pistachios were 2.46 pounds, 0.58 pounds, 0.54 pounds, and 0.60 pounds, respectively. In the 2020/21 season, the total crop value of these tree nuts was as follows: almonds, $5.6 billion; pecans, $435.3 million; walnuts, $957.7 million; and pistachios, $2.87 billion (USDA-ERS, 2022). These figures are indicative of the magnitude of the contribution of nut products to the U.S. agricultural economy. The United States is also the second-largest producer of tree nuts worldwide (Asci and Devadoss, 2021).

However, there is relatively limited research regarding the factors affecting consumption/purchase of tree nuts in the United States. Florkowski and Park (2001) analyzed the variety and uses for nut products, perceived consumer quality attributes, ease of purchase, and familiarity with marketing outlets as factors influencing pecan purchases. By estimating a generalized Heckman model of consumer purchasing decisions, marketing strategies to enhance sales of raw, unprocessed pecans were examined. A key finding of their work was that promotion programs could help stabilize and maintain the demand for pecans.

Gold, Cernusca, and Godsey (2004) conducted a study to gauge consumer familiarity with Chinese chestnuts, eastern black walnuts, and northern pecans to determine interest in buying, consuming, and preparing these nuts and the key attributes that influence purchasing decisions. The attributes included quality, price, locally grown, ease of preparation, taste, and nutrition-diet-health. Data were collected based on a survey questionnaire administered during the 2003 Missouri Chestnut Roast festival. Out of 900 attendees, 232 questionnaires were collected and analyzed. Demographic characteristics included gender, age, education level, and occupation. Quality, locally grown, and nutrition-diet-health were consistently perceived as the most important attributes influencing chestnut purchasing decisions. Three-year findings (2003, 2004, 2006) confirmed that consumers who participated in the Missouri Chestnut Roast festival value ranked product quality, local production, and nutritional value over price as a priority attribute.

Lillywhite, Simonsen, and Heerema (2014) used a web-based panel survey of 1,009 U.S. individuals to explore the demographics of consumers who purchase pecans, gauge their tree nut nutrition knowledge, and examine the preferences surrounding their purchases. Almost three-quarters (74%) of survey respondents consumed pecans; demographic differences were observed among respondents who consumed pecans and those who did not. Demographic factors included in the survey instrument were annual household income, region, gender, marital status, and race/ethnicity. Respondents' knowledge of general and tree nut nutrition concepts varied. Respondents most frequently purchased pecans from a grocery store, bought them shelled as a raw ingredient for baking/cooking, and consumed pecans four to six times per year. Results suggest pecan consumers were more likely to be 55 years of age or older. A higher proportion of African Americans and Hispanics consumed pecans than those who do not. Pecans also were more widely consumed in the southern United States than in other regions of the United States. This finding is logical given the prevalence of pecan production in southern U.S. states.

Most respondents in this investigation purchased pecans in grocery stores. The results of this study differed from those of previous research, which found that farmers' markets and other direct from-producer outlets were used with greater frequency by consumers (Lombardini, Waliczek, and Zajicek, 2008). Further, pecans were purchased predominantly as a baking ingredient. Previous research suggested that consumers often purchased pecans during the holiday season (Lombardini, Waliczek, and Zajicek, 2008).

Cheng, Capps, and Dharmasena (2021) analyzed the factors affecting 61,380 U.S. households' propensity to purchase tree nuts, specifically, pecans, almonds, cashews, walnuts, macadamia nuts, and pistachios. The source of data for their analysis was the Nielsen Homescan Panel for the calendar year 2015. Households located in different regions, households from different races and ethnicities, and seasonality were important factors affecting quantities of tree nuts purchased. Probit models were estimated to determine the factors affecting the decision to purchase or not to purchase various tree nuts. Older households, well-educated households, wealthier households, and households without children were most likely to purchase tree nuts. The propensity to purchase tree nut products was different across regions, race, and ethnicity. For the most part, the propensity to purchase tree nuts was higher in the fourth quarter of the year.

Objectives

The specific objectives of this study are threefold: (i) to provide insights on consumer beliefs, awareness, attitudes, and purchasing behavior regarding tree nuts in general and pecans specifically via an online nationally representative survey; (ii) to determine the impacts of sociodemographic factors, sources of information about tree nuts, and outlets where tree nuts are purchased on the decision to purchase pecans; and (iii) to develop the profile of households to assist stakeholders in strategically positioning pecans in the nuts market. In this way, we provide a micro-perspective viewpoint as to how sociodemographic factors and other factors influence purchasing decisions of pecans. Exploring a detailed household-level analysis for these products is worthwhile to the APC as well as other purveyors in the tree nuts industry.

Similar to the work of Lillywhite, Simonsen, and Heerema (2014), to support APC marketing and promotion activities, we constructed and administered a nationally representative online consumer survey to a panel of U.S. residents. Using SurveyMonkey,[1] a well-known online survey software application, information concerning beliefs, awareness, attitudes, and purchasing behavior about tree nuts in general and pecans, in particular, was obtained. The protocol of SurveyMonkey required all participants to be at least 18 years of age. In this study, panelists were recruited until at least 1,200 responses were obtained. This number was chosen to satisfy statistical criteria, namely a margin of error of plus or minus 3% and a confidence level of 95%,[2] as well as to conform to budgetary restrictions. The number of survey responses collected was 1,308.

The survey responses provide *qualitative* feedback relevant to APC marketing and promotion activities. They also are a unique and recent source of data for analysis and serve as a baseline going forward concerning awareness, attitudes, and purchasing behavior of consumers regarding pecans.

The questions included in the survey are exhibited in the Appendix. The survey begins with questions related to tree nuts in general and then proceeds with questions related specifically to pecans. Survey questions dealing with tree nuts include: (i) which tree nuts (e.g., almonds, walnuts, pecans, pistachios, macadamia nuts) were purchased in the past year; (ii) reasons why tree nuts were not purchased in the past year; (iii) favorite, second favorite, and third favorite tree nuts; (iv) main sources of information about tree nuts; (v) recall of seeing or hearing any advertising for any type of tree nuts; (vi) frequency of purchasing tree nuts; (vii) form of purchase of tree nuts (in the shell; raw, shelled; roasted, salted; roasted, unsalted; candied; and flavored); (viii) type of packaging of tree nuts (bulk, bag, can, and snack-size); and (ix) where tree nuts were purchased.

The list of survey questions dealing specifically with pecans include: (i) frequency of purchase of pecans; (ii) reasons why pecans were not purchased in the past year (if applicable); (iii) form of purchase of pecans (in the shell; raw, shelled; roasted, salted; roasted, unsalted; candied; and flavored); (iv) type of tree nut packaging (bulk, bag, can, and snack-size); (v) where pecans were

[1] SurveyMonkey (https://surveymonkey.com) recruits panelists for various projects every month. The panels are representative of a diverse population that voluntarily joined to participate in surveys.
[2] https://www.surveymonkey.com/mp/sample-size-calculator/

purchased; (vi) which tree nuts would serve as substitutes for pecans; (vii) what comes to mind when thinking about pecans; (viii) recall of seeing or hearing any advertising for pecans; (ix) recall of seeing or hearing any messages that encourage the purchase of pecans; and (x) what specifically would increase the likelihood of purchasing pecans.

Additionally, we capture demographics of tree nut consumers, including gender, race (white, black, Asian, and other), ethnicity (Hispanic or non-Hispanic), education level, income level, household size, number of children in the household, age, and state/region. This information will allow the APC to target segments of the U.S. population in marketing and promoting pecans. We provide a formal statistical analysis of the national survey data via the use of a qualitative choice model, specifically the probit model.

Analysis of the Survey Data

As previously discussed, the number of survey responses initially collected via SurveyMonkey was 1,308 (see Figure 1). Owing to 131 incomplete responses, however, the number of useable responses for analysis was 1,177 (90% of the respondents). Out of the 1,177 respondents, 160 did not purchase tree nuts, leaving 1,017 respondents who purchased tree nuts. Consequently, the market penetration for tree nuts is slightly more than 86%. More succinctly, close to 9 out of 10 panelists purchase tree nuts. Of those 1,017 respondents who purchased tree nuts, 234 respondents did not purchase pecans. Hence, the market penetration for pecans is roughly 67% (783 respondents out of a possible 1,177 respondents). In other words, our sample reveals that 2 out of 3 panelists purchase pecans. This finding is in accord with the work of Lillywhite, Simonsen, and Heerema (2014), who reported that almost three-quarters of survey respondents consumed pecans on a regular basis.

To demonstrate the representativeness of our sample to the U.S. population, as exhibited in Table 1, we compared the sociodemographic characteristics of our sample with population statistics provided by the Current Population Survey (CPS) (U.S. Census Bureau, 2020) and by Statista (2020). The respective sociodemographic characteristics include: (i) gender; (ii) race; (iii) household size; (iv) age; (v) region; (vi) household income; (vii) ethnicity; (viii) education level; and (ix) presence/absence of children.

The SurveyMonkey sample matches very well with the distribution of households by household size, region, and household income. However, the sample from SurveyMonkey underestimates the percentage of males and overestimates the percentage of females in the U.S. population. The sample underestimates the percentage of black and Asian households and overestimates the percentage of white households and households of other races. The other category for race includes Native Americans as well as Latino/Mexican Americans and mixed races.

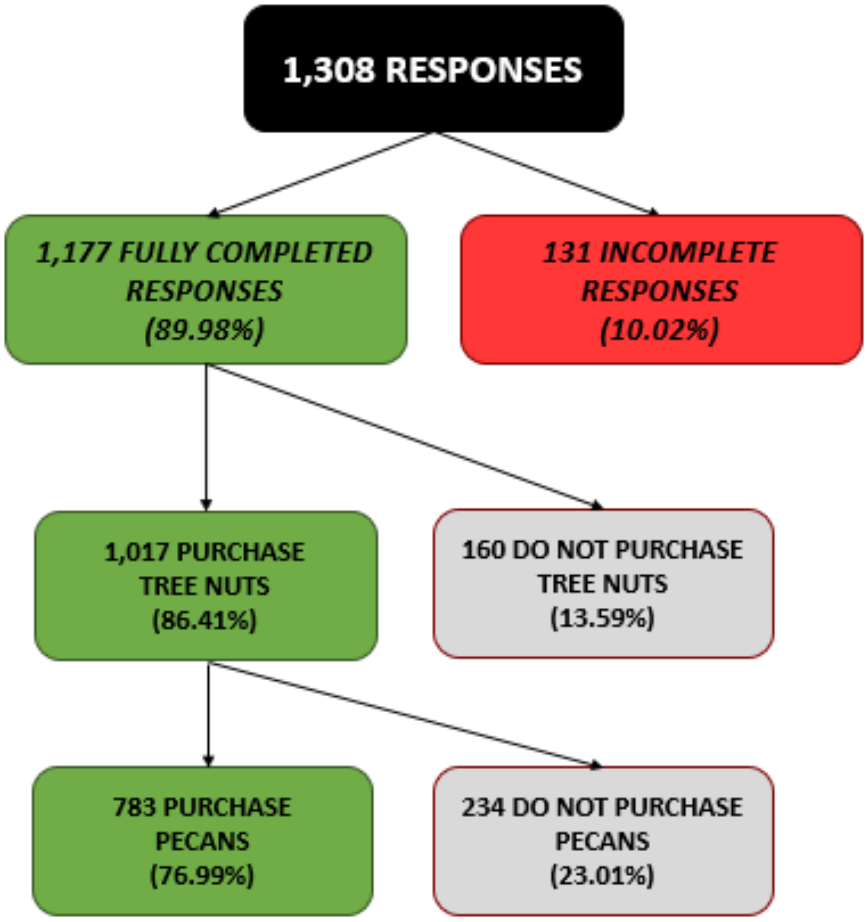


Figure 1. Schematic of Survey Responses

Further, the sample underestimates the distribution by age for the category 18–24 and overestimates the distribution by age for the 35–44 and the 65+ categories. Otherwise, the sample distribution by age for categories 25–34, 45–54, and 55–64 matches well the distribution of the age of the population. The percentage of Hispanic households (6.9%) was lower in our sample compared to the percentage of Hispanic households in the U.S. population (18.4%). Moreover, in our sample, the percentage of households whose heads received some college education or technical school training was 88.3%, compared to 61.1% of the U.S. population. Finally, the SurveyMonkey sample understates the distribution of U.S. households with children under age 18 (24.3% compared to 40.0%) and overstates the distribution of U.S. households without children under age 18 (75.7% compared to 60.0%).

Table 1. Representativeness of the SurveyMonkey Sample Data to the U.S. Population

Socio-Demographic Characteristic	2019/2020 Data[1] %	Survey Monkey Sample Data %
Male	49.3	44.2
Female	50.8	55.1
White	79.0	84.4
Black	13.5	6.0
Asian	6.0	3.7
Other	1.5	5.9
Household size—1	28.4	23.3
Household size—2	34.5	41.3
Household size—3	15.1	16.3
Household size—4	12.8	9.9
Household size—5	5.8	5.1
Household size—6	2.3	2.6
Household size—7 or more	1.2	1.5
18–24 years old	9.2	5.0
25–34 years old	14.0	13.3
35–44 years old	12.7	24.0
45–54 years old	12.5	13.9
55–64 years old	12.9	17.9
65+ years old	16.5	25.9
East north central region	14.3	15.6
East south central region	5.8	3.7
Mid-Atlantic region	12.5	14.4
Mountain region	7.6	8.7
New England region	4.5	6.1
Pacific region	16.3	18.7
South Atlantic region	20.0	17.8
West north central region	6.5	6.7
West south central region	12.4	8.3
Less than $25,000	17.1	13.3
Between $25,000 and $50,000	20.0	18.9
Between $50,000 and $75,000	16.5	17.9
Between $75,000 and $100,000	12.3	16.6
Between $100,000 and $150,000	15.5	14.9
Between $150,000 and $200,000	8.3	9.0
Greater than $200,000	10.3	9.4
Hispanic	18.4	6.9
Not Hispanic	81.6	93.1
Less than high school education	10.6	1.9
High school graduate	28.3	9.9

Table 1. (cont)

Socio-Demographic Characteristic	2019/2020 Data[1] %	Survey Monkey Sample Data %
Some college	23.6	20.2
College graduate	21.3	35.3
Post college	12.1	28.0
Technical school	4.1	4.8
Absence of children	60.0	75.7
Presence of children	40.0	24.3

[1]Source: U.S. Census Bureau (2020) and Statista (2020)

These sample characteristics are in accord with Lillywhite, Simonsen, and Heerema (2014), who found that survey respondents diverged from the general U.S. population in age, gender, and race. Consequently, inferences to the general population should be made with an awareness of the limitations of the survey methodology used. Bottom line, aside from differences in gender, race, ethnicity, education, and absence/presence of children, the sample from SurveyMonkey can be considered representative of the U.S. population.

In the next section, we summarize the 1,177 qualified respondents on a question-by-question basis. We initially focus on tree nuts in general and then center attention on pecans specifically.

Survey Responses Concerning Tree Nuts in General

Q: What tree nuts have you purchased in the past year? (Check all that apply.)

In the past year, the most frequently purchased tree nuts were almonds, cashews, pistachios, walnuts, and pecans, in that order. Roughly 68% of respondents purchased almonds in the past year, 62% purchased cashews, 49% purchased pistachios, 48% purchased walnuts, 48% purchased pecans, 19% purchased macadamia nuts, and 15% purchased hazelnuts (Figure 2). Candied nuts (12%) and Brazil nuts (12%) were among the various tree nuts purchased in the past year.

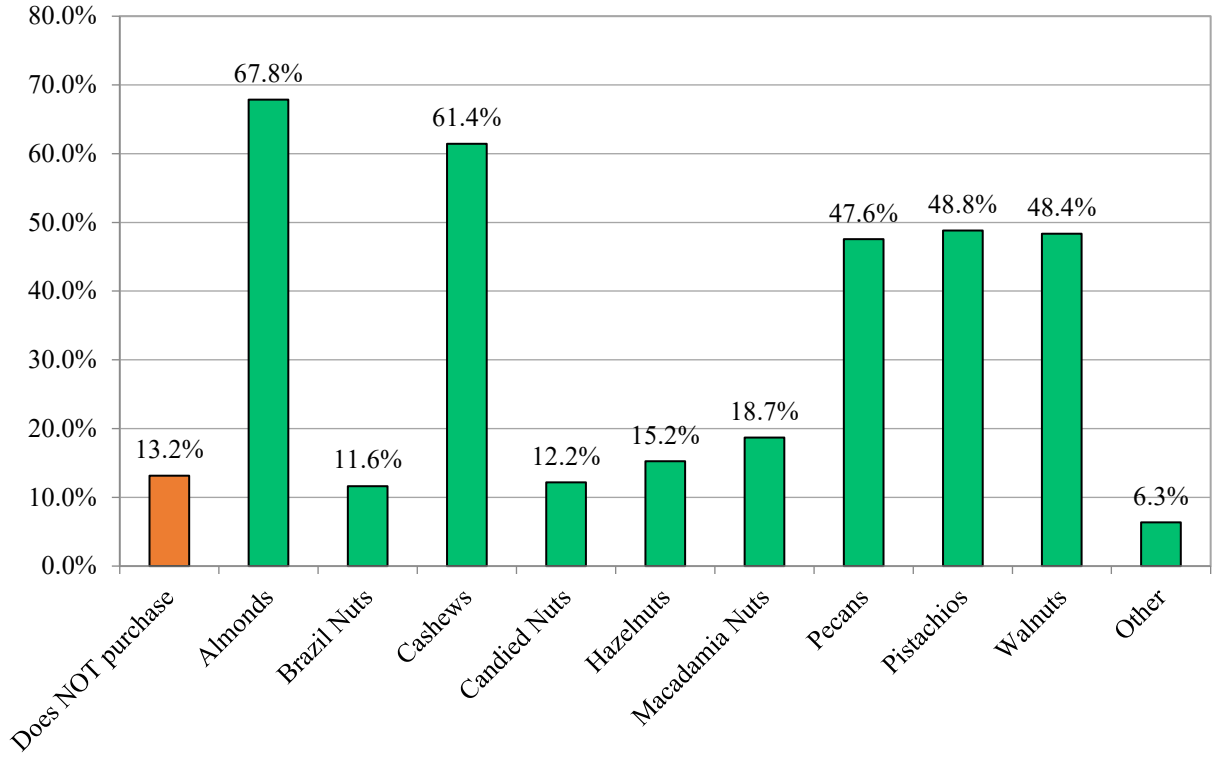
Q: If you did NOT purchase tree nuts in the past year, what is (are) your reason(s)? (Check all that apply.)

Of the 155 sample respondents who did not purchase tree nuts, 43% of them simply did not like tree nuts. Close to 14% had cost/budgetary restrictions, 10% were allergic to tree nuts, and slightly more than 8% had dietary restrictions (see Figure 3).

Q: What are your favorite tree nuts?

As depicted in Figure 4, roughly 32% of the respondents listed cashews as their favorite tree nut, followed by almonds (22%), pistachios (15%), pecans (12%), macadamia nuts (6%), and walnuts (6%). About 2% of respondents did not indicate a favorite tree nut. Second favorite tree nuts were cashews (21%), almonds (19%), pistachios (18%), pecans (14%), walnuts (10%), and macadamia nuts (8%). Third favorite tree nuts were pistachios (18%), almonds (18%), walnuts (16%), pecans

(15%), cashews (12%), and macadamia nuts (9%). Of importance to the American Pecan Council, pecans ranked fourth among total respondents listing them as their favorite, second favorite, or third favorite tree nut. Overall, the top tree nuts are cashews, almonds, pistachios, pecans, walnuts, and macadamia nuts, in that order.



Note: Other category responses include mixed nuts, peanuts, chestnuts, pine nuts, pumpkin seeds, sunflower seeds, Japanese nuts, etc.

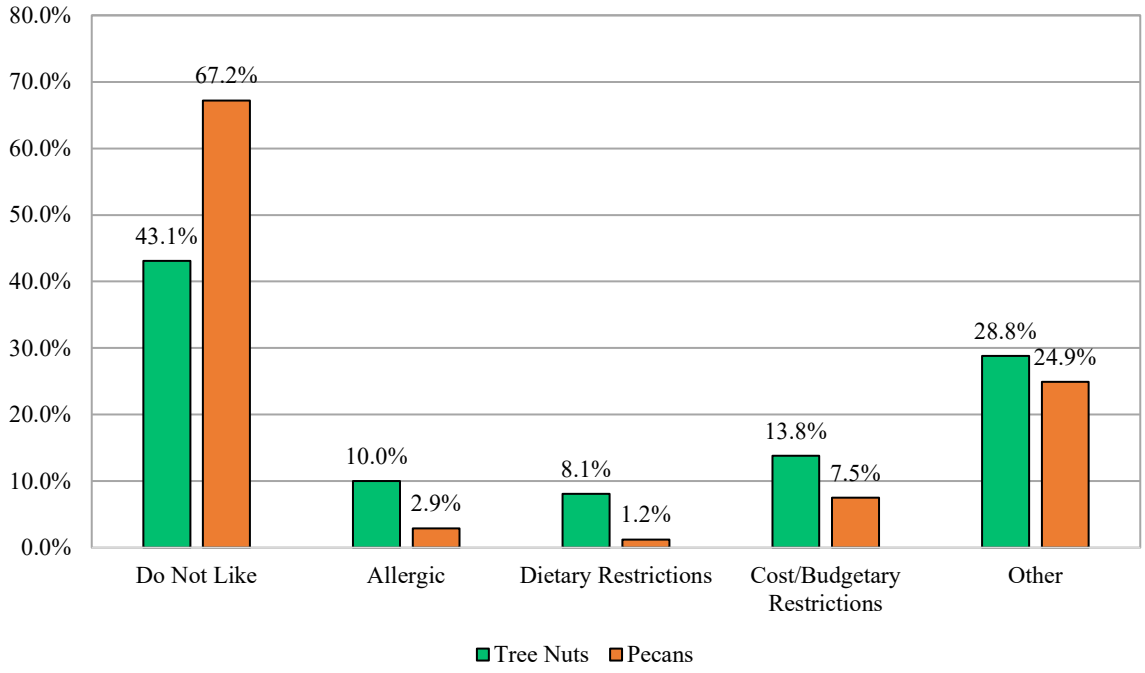
Figure 2. Tree Nuts Purchased in the Past Year

Q: What is (are) your main source(s) of information about tree nuts? (Check all that apply.)

By far, the main source of information about tree nuts is past experience (61%), followed by package labels (38%), recipes (32%), and friends and family (25%). Magazines (11%), television (10%), and radio (3%) are additional sources of information about tree nuts (see Table 2). However, Facebook (4%) and Twitter (0.5%) are not primary sources of information about tree nuts. The other category (10.3%) included open responses indicating Pinterest, Google, Yahoo, YouTube, and medical and nutritional websites as principal sources of information about tree nuts.

Q: Within the past year, do you recall seeing or hearing any advertising for any type of tree nut?

Nearly 50% of those surveyed recall seeing or hearing advertising for some type of tree nut (Figure 5). Close to 30% did not hear any advertising for any tree nuts, and slightly over 20% do not recall seeing or hearing any advertising for any tree nuts.



Note: Other category responses include not the main shopper, painful to eat nuts, no interest, no reason/need, prefer other tree nuts, prefer to purchase in pies, etc.

Figure 3. Reasons Behind NOT Purchasing Tree Nuts and Pecans

Table 2. Main Sources of Information Regarding Tree Nuts and Pecans

Source	Percentage Tree Nuts	Percentage Pecans
Facebook	4.1%	1.7%
Twitter	0.5%	0.7%
Television	10.6%	9.9%
Radio	2.7%	1.5%
Magazines	11.1%	7.3%
Friends and family	25.0%	10.7%
Recipes	32.1%	22.0%
Past experience	60.8%	N/A
Package labels	37.4%	N/A
Billboards	N/A	0.9%
I do not recall.	N/A	63.8%

Note: Other category responses include Pinterest, Google, Yahoo, YouTube, and medical and nutritional websites.

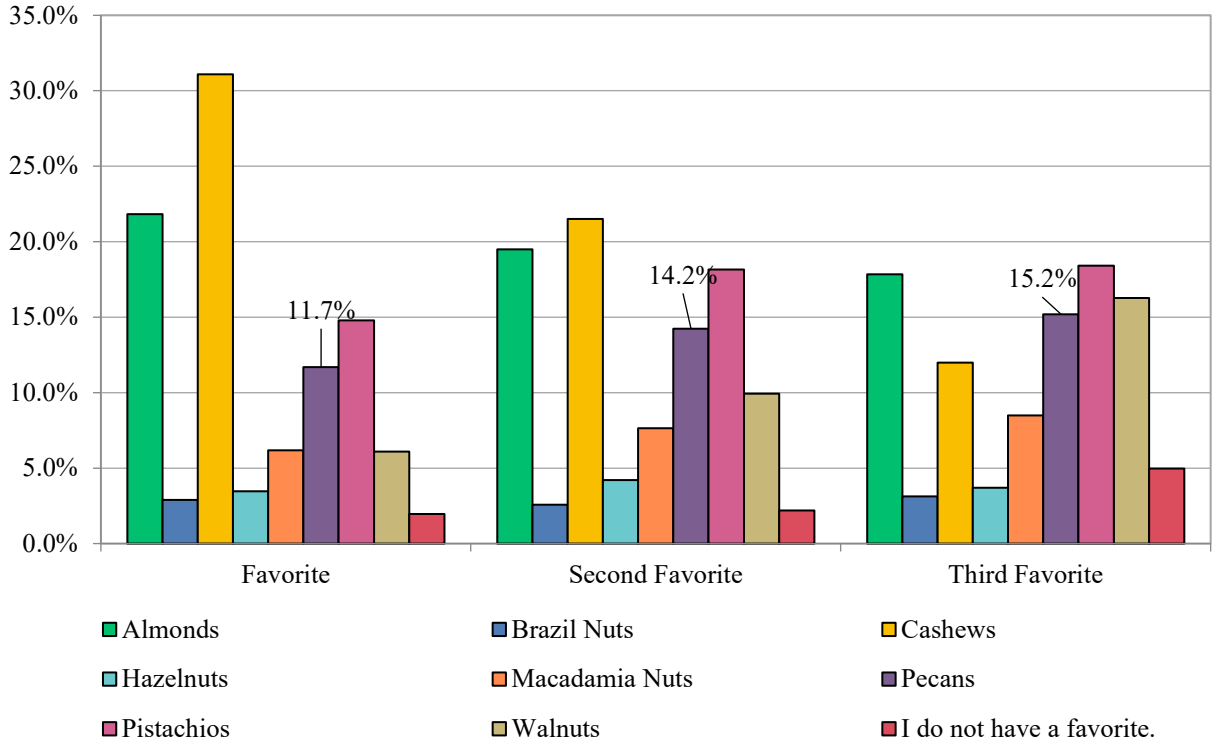


Figure 4. Top Three Favorite Tree Nuts

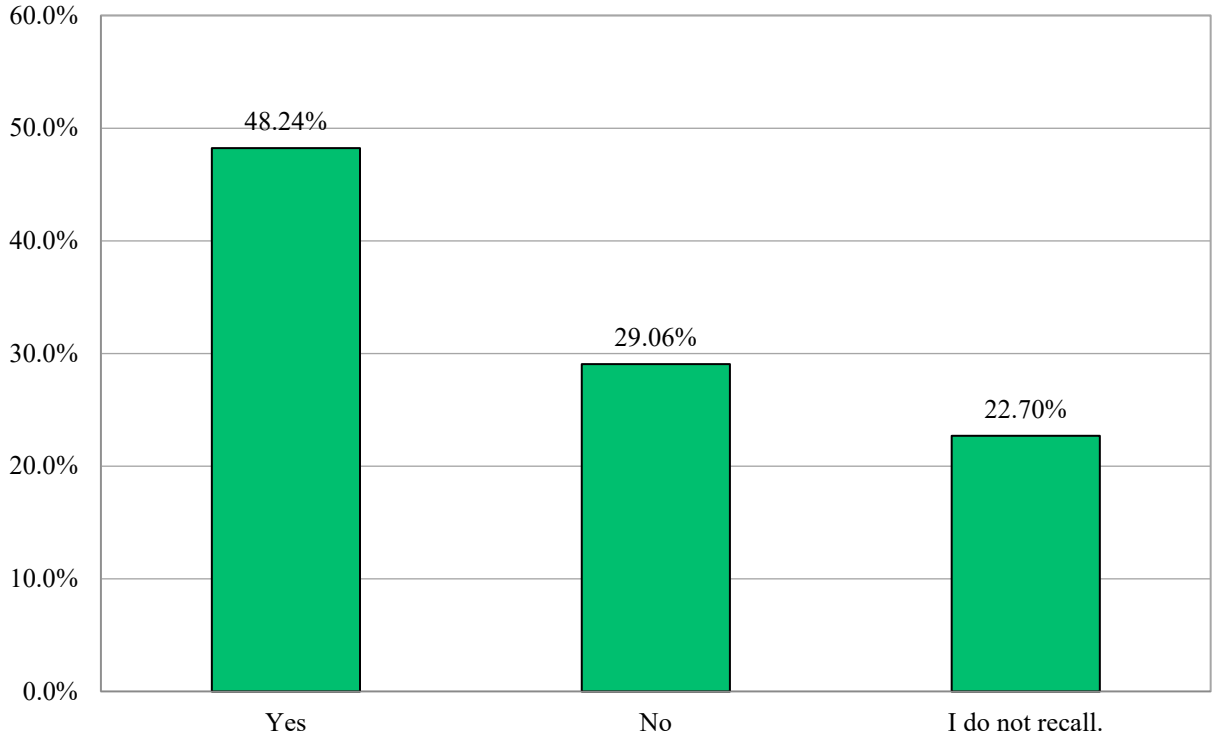


Figure 5. Recollection of Tree Nut Advertising

Q: How often do you purchase tree nuts?

Close to 60% of respondents purchase tree nuts monthly (see Figure 6). Slightly less than 25% purchase tree nuts annually, while slightly more than 10% purchase tree nuts on a weekly basis. About 8% of the respondents purchase tree nuts only during holidays.

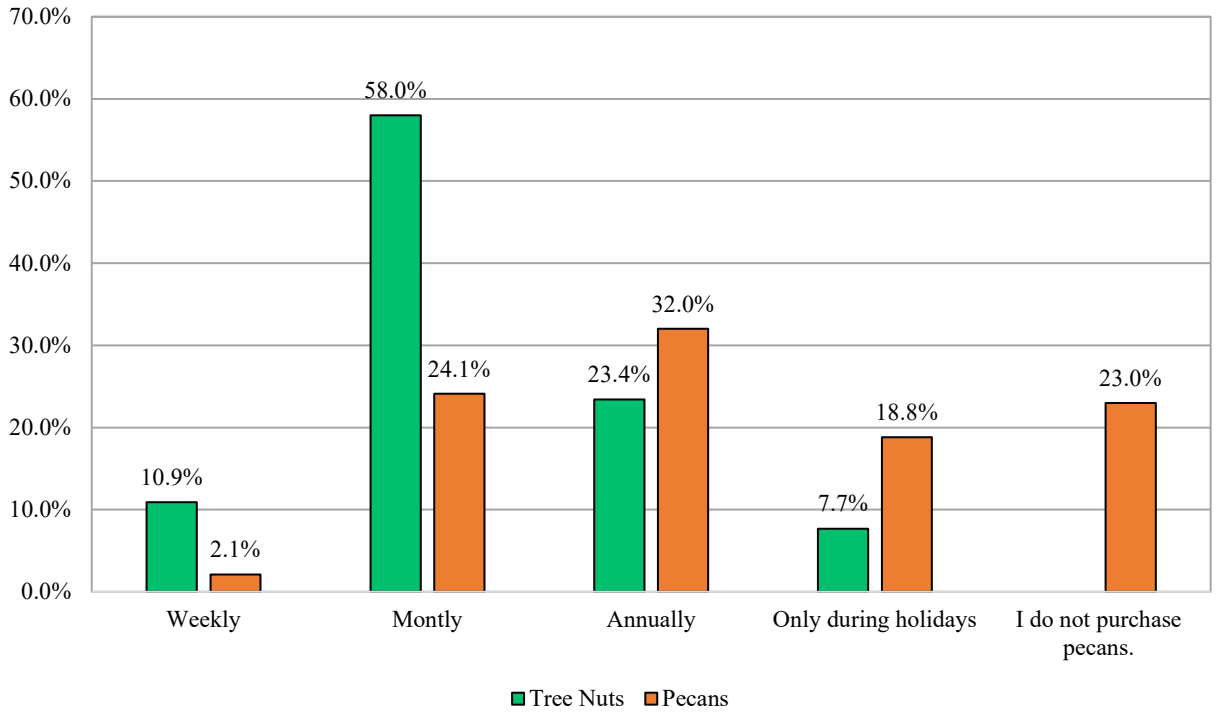


Figure 6. Frequency of Tree Nuts Purchases and Pecan Purchases

Q: In what form do you purchase tree nuts?

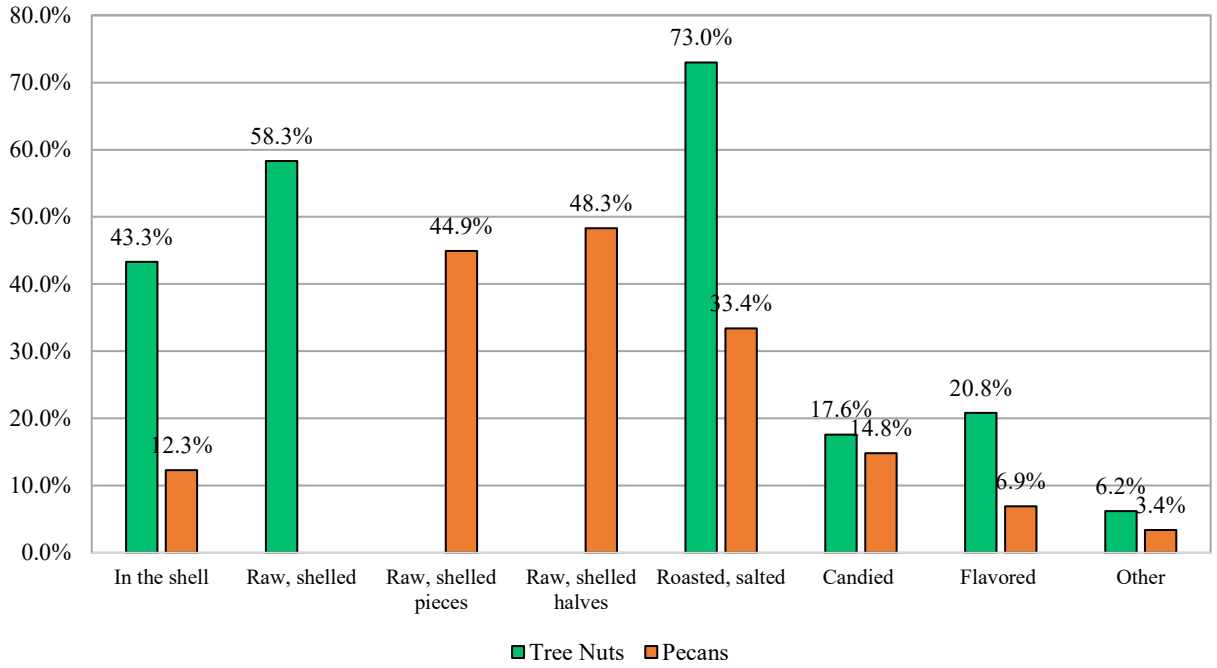
The most common forms of purchases of tree nuts are roasted, salted (73%), followed by raw, shelled (58%), and in the shell (43%) (see Figure 7). Flavored (21%) and candied (18%) forms of purchases also were evident.

Q: In what type of packaging do you purchase tree nuts? (Check all that apply.)

The most predominant type of packaging for purchases of tree nuts is bags (83%) (Figure 8). The next most common type of packaging is cans (48%), followed by snack-size (29%) and in bulk (24%).

Q: Where do you purchase tree nuts? (Check all that apply.)

Roughly 5 out of 6 respondents purchase tree nuts at grocery stores, and nearly 3 of 5 respondents purchase tree nuts at supercenters, such as Walmart, Sam's Club, or Target (Table 3). Additional purchasing locations are convenience stores (18%), farmers' markets (12%), specialty stores (11%), Amazon (9%), roadside stands (6%), other online sources (4%), and mall kiosks (1%). Costco and pharmacies also are notable places for purchasing tree nuts.



Note: Other category responses include nut spread; nut milk; roasted, unsalted; honey roasted; chopped; pecan pie; roasted and unsalted; mixed nuts, etc.

Figure 7. Form of Tree Nuts Purchases and Pecan Purchases

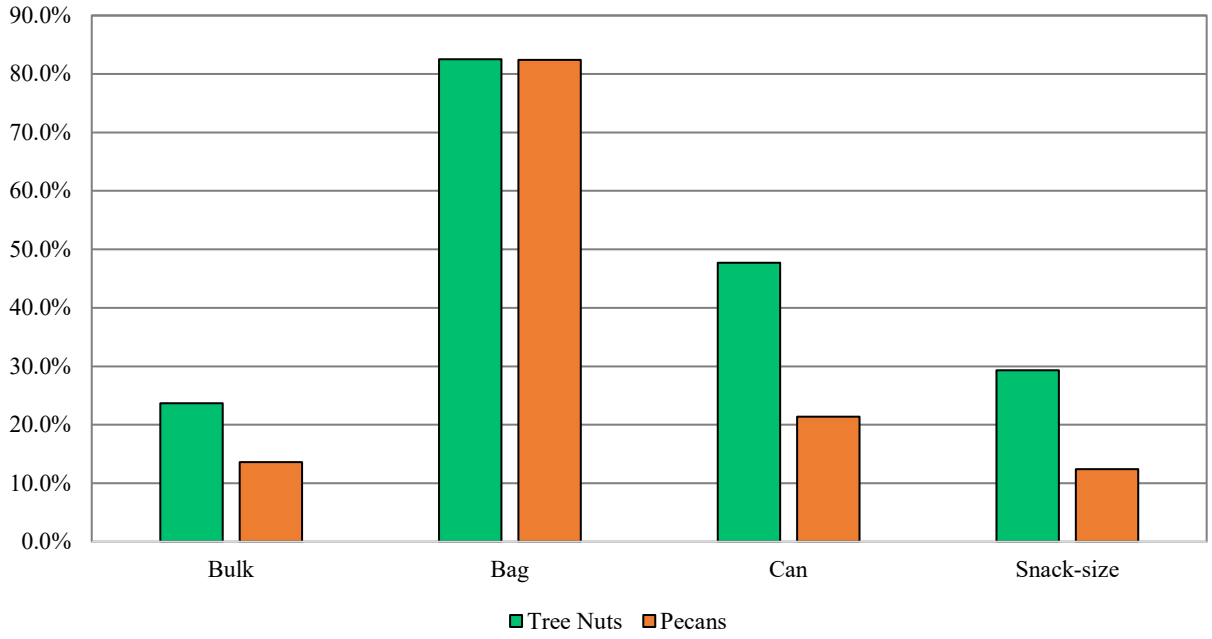


Figure 8. Packaging Type of Purchased Tree Nuts and Pecans

Survey Responses Concerning Pecans Specifically

Q: How often do you purchase pecans?

About 23% of respondents who purchase tree nuts do not purchase pecans. The most common frequency of pecan purchases is annually (Figure 6). The second most common purchase frequency is monthly. A notable number of respondents also purchase pecans during the holidays, particularly Thanksgiving and Christmas, for baking and candies. Relatively few respondents purchase pecans on a weekly basis. The frequency of pecan purchase differs considerably from the frequency of tree nut purchases in general.

Q: If you did NOT purchase pecans in the past year, what is (are) your reason(s)? (Check all that apply.)

The primary reason for not purchasing pecans given by non-purchasers is that 67% of these respondents simply do not like pecans (Figure 3). Cost/budgetary restrictions are a secondary reason for not purchasing pecans, as are dietary restrictions and pecan allergies. Other category responses primarily were no need; prefer other tree nuts; and prefer to purchase in pies.

Q: In what form do you purchase pecans? (Check all that apply.)

As exhibited in Figure 7, the most common form of pecan purchases is raw, shelled halves (48%) and raw, shelled pieces (45%), followed by roasted, salted (34%), candied (15%), in the shell (12%), and flavored (7%). The form of pecan purchases differs markedly from the form of tree nut purchases in general. Other category responses include chopped; pecan pie; roasted and unsalted, mixed nuts, etc.

Q: In what type of packaging do you purchase pecans? (Check all that apply.)

The most predominant type of packaging for pecan purchases is bags (82%) (Figure 8), followed by cans, (21%), in bulk (14%), and snack-size (12%). Opportunities may exist for stakeholders in the pecan industry to pursue packaging in cans or for snack sizes.

Q: Where do you purchase pecans? (Check all that apply.)

Roughly 4 of 5 respondents purchase pecans at grocery stores, and nearly half of the respondents purchase pecans at supercenters, such as Walmart, Sam's Club, or Target (Table 3). This finding is very similar to other places to purchase other tree nuts. Additional places to purchase pecans are specialty stores (8%), farmers' markets (8%), convenience stores (7%), roadside stands (4%), Amazon (4%), other online sources (3%), and mall kiosks (2%). Additionally, pecans are also purchased at Costco and pharmacies such as CVS and Walgreen's.

Table 3. Where Tree Nuts and Pecans Are Purchased

Location Description	Percentage Tree Nuts	Percentage Pecans
Grocery stores (e.g., HEB, Kroger, Whole Foods)	83.1	77.8
Supercenters (e.g., Walmart, Sam's Club, Target)	55.8	48.0
Roadside stands	5.8	4.3
Farmers' markets	11.6	7.5
Convenience stores	17.4	7.3
Specialty stores	10.4	7.8
Mall kiosks	1.3	1.8
Amazon	8.7	4.1
Other online sources	4.1	2.9
Other (Costco, Trader Joe's, CVS, Walgreens, family/friends)	6.6	5.6

Q: If pecans were not available for their intended use, which of the following would serve as a substitute for that purpose? (Check all that apply.)

Walnuts, by far, are the most popular substitute for pecans, according to survey respondents (Figure 9). About 55% of respondents revealed that walnuts would serve as a substitute for pecans. Interestingly, almonds came in second as a substitute for pecans, with 26% of respondents selecting almonds. Other notable potential substitutes for pecans are cashews (20%) and pistachios (12%). Macadamia nuts (7%), hazelnuts (7%), and Brazil nuts (4%) also are potential substitutes for pecans. Of particular importance is the finding that nearly 20% would not purchase a substitute if pecans were not available for their intended use.

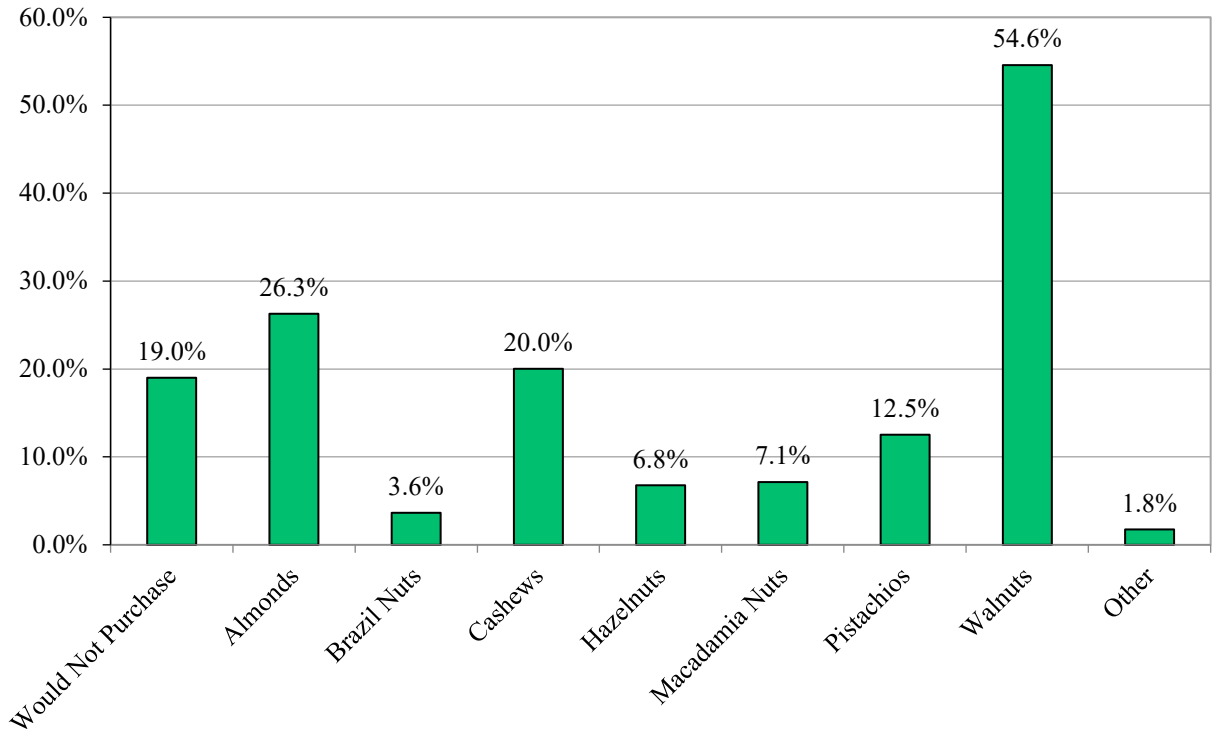


Figure 9. Substitutes for Pecans

Q: What comes to mind when you think about pecans? (Check all that apply.)

A number of things come to consumers' minds when thinking about pecans, including ingredient for cooking or pies (56%), delicious desserts (35%), and family/holiday gatherings (31%) (Table 4). Additional perceptions of pecans are wholesome (26%), heart-healthy (25%), and expensive (22%), followed by packed with multiple health-promoting nutrients (18%), heart-smart food (16%), nutrition powerhouse (14%), high caloric content (10%), and homegrown (9%). For close to 11% of respondents, pecan perceptions include family memories, Texas, snack, delicious/tasty, pecan pies, southern states, and squirrels. About 2% to 3% of survey respondents mentioned that pecans are America's only major native tree nut, the original supernut, and contribute to a decreased risk of mortality. For about 1 in 6 respondents, nothing comes to mind when thinking about pecans.

Table 4. What Comes to Mind When the Respondents Think about Pecans

Description	Percentage
Nothing comes to mind	15.9
Wholesome	25.7
Homegrown	9.4
Heart-healthy	24.6
High caloric content	9.9
Packed with multiple health-promoting nutrients	17.7
Nutrition powerhouse	14.2
The original super nut	1.9
Heart-smart food	16.4
Expensive	22.3
Linked to a decreased risk of mortality	2.2
America's only major native tree nut	2.8
Ingredient for cooking or pies	56.2
Family/holiday gatherings	30.6
Delicious desserts	34.5
Other (family memories, Texas, snack, delicious/tasty, squirrels)	10.8

Q: Where specifically do you recall seeing or hearing messages that would encourage you to purchase pecans? (Check all that apply.)

Slightly more than 60% of respondents do not recall seeing or hearing messages that would encourage them to purchase pecans (Table 2). The predominant source of messaging comes from recipes (22%). Additional sources of messaging include friends and family (11%), television (10%), and magazines/newspapers (7%). Respondents do not recall seeing or hearing messages that would encourage them to purchase pecans on social media such as Facebook and Twitter.

Q: What specifically would make you more likely to purchase more pecans? (Check all that apply.)

Slightly more than 40% of respondents revealed that lowering the price would make them more likely to purchase more pecans (Table 5). Roughly 28% placed emphasis on health and nutrition considerations that would make them more likely to purchase more pecans. Additional suggestions to improve the likelihood of purchasing more pecans include: (i) recipes featuring pecans (25%); (ii) promotional specials (coupons, etc.) (18%); (iii) more variety in available pecans (roasted, salted, spiced, candied, etc.) (14%); (iv) more information in general about pecans (11%); (v) wider availability (9%); and (vi) advertising and promoting pecans (8%). Roughly 20% of respondents did not know what would make them more likely to purchase more pecans. Moreover, close to 8% of those surveyed said nothing would make them more likely to purchase more pecans.

Table 5. What Would Make Respondents More Likely to Purchase Pecans?

Description	Percentage
Health and nutrition considerations	27.9
Wider availability	9.0
More variety in available pecans (roasted, salted, spiced, candied, etc.)	13.8
More information in general about pecans	10.9
Lower price	43.3
Promotional specials (coupons, etc.)	18.2
Advertising and promotion about pecans	8.2
Recipes featuring pecans	24.5
I do not know	20.3
Other (predominantly nothing)	7.8

Econometric Analysis of the Decision by Consumers to Purchase Pecans

To delve deeper into the decision by consumers of whether or not to purchase pecans, an econometric analysis was conducted using a probit regression model based on the survey results. The use of probit models is commonplace in economic analyses of the food industry (Byrne, Capps, and Saha, 1996; Alviola and Capps, 2010; Capps, Ahad, and Murano, 2017). The probit regression model in this analysis is a binary choice model, where the dependent variable takes on two values—zero for non-purchases of pecans and 1 for purchases of pecans by reference person *i*. The reference person in the household is the household head who completed the survey.

The use of the probit/logit analysis, particularly of binary choices, is well established in the economic literature (Maddala, 1983; McFadden, 1984; Pindyck and Rubinfeld, 1998). Capps and Kramer (1985) demonstrated that the probit and logit models yield similar results in binary choice models. Additionally, since the logistic density function closely resembles the *t*-distribution with seven degrees of freedom (Hanushek and Jackson, 1977), the logit and probit formulations are quite similar. The only difference is that the logistic density has a slightly heavier tail than the standard normal density.

Mathematically, the probit model takes the following form:

$$y_i = \boldsymbol{x}_i'\boldsymbol{\beta} + e_i$$

$$y_i = 1 \quad \text{if purchases of pecans were made by reference person } i$$

$$y_i = 0 \quad \text{if no purchases of pecans were made by reference person } i \qquad (1)$$

and

$$\Pr(\, y_i = 1 \,|\, \boldsymbol{x}_i') = \Phi(\boldsymbol{x}_i'\boldsymbol{\beta}) \,, \qquad (2)$$

where Φ is the cumulative distribution function (CDF) of the standard normal distribution; $\boldsymbol{x}_i'$ is a column vector of explanatory variables; $\boldsymbol{\beta}$ is a vector of parameters associated with the explanatory variables; and e_i is the random error. Operationally, the decision to purchase pecans is denoted by Purchase_Pecans and is defined in equation (3) as:

$$\text{Purchase\_Pecans}_i=\beta_0+\beta_1*\text{Household\_Size}_i+\beta_2*\text{Number\_Children}_i+\beta_3*\text{Male}_i+\beta_4*\text{Black}_i \quad (3)$$

$$+\beta_5*\text{Asian}_i+\beta_6*\text{White}_i+\beta_7*\text{Hispanic}_i+\beta_8*\text{College}_i+\beta_9*\text{Age\_25to34}_i+\beta_{10}*\text{Age\_35to44}_i$$

$$+\beta_{11}*\text{Age\_45to54}_i+\beta_{12}*\text{Age\_55to64}_i+\beta_{13}*\text{Age\_65Plus}_i+\beta_{14}*\text{Hincome}_i+\beta_{15}*\text{New England}_i+$$

$$\beta_{16}*\text{Mid\_Atlantic}_i+\beta_{17}*\text{East\_North\_Central}_i+\beta_{18}*\text{West\_North\_Central}_i+\beta_{19}*\text{South\_Atlantic}_i+$$

$$\beta_{20}*\text{East\_South\_Central}_i+\beta_{21}*\text{West\_South\_Central}_i+\beta_{22}*\text{Mountain}_i+\beta_{23}*\text{SOR\_Social Media}_i$$

$$+\beta_{24}*\text{SOR\_Friends\_Family}_i+\beta_{25}*\text{SOR\_Internet}_i+\beta_{26}*\text{SOR\_Conv\_Media}_i+$$

$$\beta_{27}*\text{SOR\_Package\_Labels}_i+\beta_{28}*\text{SOR\_Past\_Experience}_i+\beta_{29}*\text{SOR\_Recipes}_i$$

$$+\beta_{30}*\text{Grocery\_Stores}_i+\beta_{31}*\text{Supercenters}_i+\beta_{32}*\text{Convenience\_Stores}_i+\beta_{33}*\text{Farmer\_Direct}_i$$

$$+\beta_{34}*\text{Online\_Purch\_Tree\_Nuts}_i+\beta_{35}*\text{Other\_Stores}_i+e_i$$

The explanatory variables correspond to sociodemographic factors, namely household size, number of children living in the household, gender, race, ethnicity, education, age, household income, and region. Gender, race, ethnicity, education, age, and region are indicator or dummy variables. As such, these variables take on the value of 1 or 0. For example, Male = 1 if the respondent is male, and 0 if the respondent is female. The base or reference categories for the respective discrete or dummy variables are as follows: (i) gender: female; (ii) race: other; (iii) ethnicity: non-Hispanic; (iv) education: no college; (v) age: 18 to 24 years of age; and (vi) region: Pacific.

Hill and Lynchehaun (2002) and Dharmasena and Capps (2014) identified various cultural and socioeconomic factors influencing consumer preferences, including age, ethnicity, income, education, gender, presence of children, region, and race. Hence, we hypothesize that these factors also are determinants of the decision to purchase pecans. Further, because education level often is positively associated with health consciousness (Alviola and Capps, 2010), we hypothesize that this sociodemographic factor is positively related to the decision to purchase pecans. Moreover, given that pecans are produced predominantly in Alabama, Arkansas, Arizona, California, Florida, Georgia, Kansas, Louisiana, Missouri, Mississippi, North Carolina, New Mexico, Oklahoma, South Carolina, and Texas, we expect that respondents located in the South Atlantic, the East South Central, and the West South Central regions are more likely to purchase pecans than respondents located in other regions.

The specification of the probit model also includes additional indicator variables to reflect the main sources of information about tree nuts (see Table 2) and where tree nuts (not just pecans) are purchased (see Table 3). Lillywhite, Simonsen, and Heerema (2014) found that U.S. tree nut stakeholders capitalized on nutritional aspects by incorporating health messages about their products in promotional campaigns. This finding suggests that it is not unreasonable to consider main sources of information about tree nuts and their impact on the likelihood of purchasing pecans. In addition, Florkowski and Park (2001) found that marketing outlets were factors influencing pecan purchases. Lombardini, Waliczek, and Zajicek (2008) found that farmers' markets and other direct from-producer outlets were used with greater frequency by consumers than other outlets. The extant literature has paid little attention to the impact of main sources of information about tree nuts and where tree nuts are purchased on the likelihood of purchasing pecans. This research fills this void.

SOR_Social_Media is equal to 1 if the reference person relies on the use of Facebook or Twitter for information about tree nuts, and 0 otherwise. SOR_Family_Friends is equal to 1 if the reference person relies on the use of family or friends for information about tree nuts, and 0 otherwise. SOR_Internet is equal to 1 if the reference person relies on the use of the internet for information about tree nuts, and 0 otherwise. SOR_Conv_Media is equal to 1 if the reference person relies on radio, television, or magazines for information about tree nuts, and 0 otherwise. SOR_Package_Labels is equal to 1 if the reference person relies on the use of package labels, and 0 otherwise. SOR_Past_Experience is equal to 1 if the reference person relies on the use of past experience, and 0 otherwise. Finally, SOR_Recipes is equal to 1 if the reference person relies on the use of recipes, and 0 otherwise.

Grocery_Stores is equal to 1 if the reference person purchases tree nuts at grocery stores, and 0 otherwise. Supercenters is equal to 1 if the reference person purchases tree nuts at supercenters, and 0 otherwise. Convenience_Stores is equal to 1 if the reference person purchases tree nuts at convenience stores, and 0 otherwise. Farmer_Direct is equal to 1 if the reference person purchases tree nuts at roadside stands or farmers' markets, and 0 otherwise. Online_Purch_Tree_Nuts is equal to 1 if the reference person purchases tree nuts on Amazon or on other online sources, and 0 otherwise. Other_Stores is equal to 1 if the reference person purchases tree nuts at specialty stores, mall kiosks, drug stores, or discount stores, and 0 otherwise.

Data for the Econometric Analysis

As mentioned previously, the survey response data for this analysis came from a national panel of U.S. residents via SurveyMonkey.[3] The survey was administered in December 2020. The dataset used in this analysis consists of 944 observations. Each observation corresponds to a unique respondent *i*. Thus, the data set is equivalent to a cross-sectional representation of U.S. households. Prior to data cleaning, the original sample size was 1,308 observations. We dropped 131 households who failed to complete the survey, and we dropped 183 households who failed to report gender, household income, and/or region.

[3] https://www.surveymonkey.com

About 67% of the sample purchased pecans (see Table 6). Concerning age, 4% of the sample were 18 to 24 years old; 14% were 25 to 34 years old; 26% were 35 to 44 years old; 14 % were 45 to 54 years old; 18% were 55 to 64 years old; and 25% were 65 years old and over. Household size was about 2.5, and the average income was roughly $80,000. Roughly 83% of the sample had at least some college education (college) and slightly less than 45% of the sample were male. Approximately 7% were of Hispanic ethnicity. Further, roughly 85% of the sample were white, 6% were Black, and about 3% were Asian.

Table 6. Descriptive Statistics of the Variables in the Probit Analysis

Variable Name	Mean	Variable Name	Mean
Purchase Pecans		**Source of Information about Tree Nuts**	
(Dependent variable in the probit model)		SOR_SOCIAL_MEDIA social media (Facebook, Twitter)	0.0402
Yes	0.6680	SOR_FRIENDS_FAMILY friends and family	0.2173
No	0.3320	SOR_INTERNET—internet	0.0412
Race		SOR_CONV_MEDIA—conventional media (tv, radio, magazines)	0.1600
White	0.8481	SOR_PACKAGE_LABELS package labels	0.3260
Black	0.0644	SOR_PAST_EXPERIENCE past experience	0.5302
Asian	0.0332	SOR_RECIPES recipes	0.2746
Other (reference/base category)	0.0543	**Where Tree Nuts are Purchased**	
Region		GROCERY_STORES grocery stores	0.7324
New England	0.0584	SUPERCENTERS supercenters	0.4899
Mid-Atlantic	0.1368	CONVENIENCE_STORES convenience stores	0.1579
East North Central	0.1519	FARMER_DIRECT roadside stands and farmers' markets	0.1338
West North Central	0.0644	ONLINE_PURCH_TREE_NUTS Amazon and other online sources	0.1127
South Atlantic	0.1782	OTHER_STORES mall kiosks, drugstores, specialty stores, and discount stores	0.1147
East South Central	0.0423		
West South Central	0.0825		
Mountani	0.0946		
Pacific (reference/base category)	0.1911		
Household income			
Hincome	$80,636		
Household size			
Household_Size	2.46		
Education			
College	0.8300		
No college (reference/base category)	0.1700		
Gender			
Male	0.4497		
Female (reference/base category)	0.5503		

Table 6. (cont)

Variable Name	Mean	Variable Name	Mean
Purchase Pecans			
Ethnicity			
Hispanic	0.0714		
Non-Hispanic (reference/base category)	0.9286		
Age			
Age_18to24 (reference/base category)	0.0402		
Age_25to34	0.1388		
Age_35to44	0.2555		
Age_45to54	0.1408		
Age_55to64	0.1771		
Age_65plus	0.2475		
Number of children			
Number_Children	0.4809		

Source: Calculated by the authors using IHS Global, Inc.'s (2020) EVIEWS econometrics software package.

Approximately 6% of the sample were located in the New England region (Connecticut, Maine. Massachusetts, New Hampshire, Rhode Island, and Vermont); 14% were in the mid-Atlantic region (New Jersey, New York, and Pennsylvania); 15% were in the East North Central region (Indiana, Illinois, Michigan, Ohio, and Wisconsin); 6% were in the West North Central region (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota); 18% were in the South Atlantic region (Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia); 4% were in the East South Central region (Alabama, Kentucky, Mississippi, and Tennessee); 8% were in the West South Central region (Arkansas, Louisiana, Oklahoma, and Texas); 9% were in the Mountain region (Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, and Wyoming); and 19% were in the Pacific region (Alaska, California, Hawaii, Oregon, and Washington).

Roughly 53% of the sample relied on past experience as their source of information about tree nuts, followed by package labels (33%), recipes (27%), friends and family (22%), and conventional media (16%). Only 4% of the sample relied on the use of social media (Facebook and Twitter) and the use of the internet for information about tree nuts. About 73% of the sample purchased tree nuts at grocery stores, and 49% purchased tree nuts at supercenters. Roughly 15% of the sample purchased tree nuts at convenience stores, 13% at roadside stands or farmers' markets, 11% from Amazon or other online sources, and 11% at specialty stores, mall kiosks, drug stores, or discount stores.

Probit Model Results

A maximum likelihood procedure with the IHS Global, Inc.'s (2020) EVIEWS econometrics software package was used to estimate the probit model. The parameter estimates, standard errors,

and associated *p*-values of the respective explanatory variables in the probit model are exhibited in Table 7. The goodness-of-fit statistic, McFadden's (1984) R^2, is 0.2368. The overall significance of the probit regression model was examined using a likelihood ratio test. Specifically, we tested the null hypothesis that all estimated coefficients, except the intercept coefficient, are jointly equal to zero. The *p*-value associated with the likelihood ratio test (see Table 7) suggests the null hypothesis is rejected, and therefore, at least one of the estimated coefficients is statistically different from zero.

Table 7. Econometric Results from the Probit Analysis of the Purchase of Pecans

Variable*	Coefficient	Std. Error	z-Statistic	Prob.
C	**-1.3903*** **	**0.3902**	**-3.5628**	**0.0004**
HOUSEHOLD_SIZE	0.0531	0.0537	0.9889	0.3227
NUMBER_CHILDREN	-0.0936	0.0759	-1.2335	0.2174
MALE	0.0843	0.0998	0.8455	0.3978
BLACK	0.0700	0.3085	0.2270	0.8204
ASIAN	-0.5093	0.3345	-1.5226	0.1278
WHITE	-0.2489	0.2383	-1.0446	0.2962
HISPANIC	0.0735	0.2047	0.3590	0.7196
COLLEGE	0.0800	0.1303	0.6140	0.5392
AGE_25TO34	0.1608	0.2567	0.6265	0.5310
AGE_35TO44	0.1590	0.2471	0.6432	0.5201
AGE_45TO54	**0.4694***	**0.2619**	**1.7921**	**0.0731**
AGE_55TO64	**0.8290*** **	**0.2620**	**3.1639**	**0.0016**
AGE_65PLUS	**0.7899*** **	**0.2592**	**3.0480**	**0.0023**
HINCOME	6.78E-07	9.37E-07	0.7232	0.4696
NEW_ENGLAND	0.1621	0.2162	0.7499	0.4533
MID_ATLANTIC	-0.0278	0.1616	-0.1720	0.8635
EAST_NORTH_CENTRAL	0.0672	0.1634	0.4111	0.6810
WEST_NORTH_CENTRAL	**0.4397** **	**0.2217**	**1.9833**	**0.0473**
SOUTH_ATLANTIC	**0.3397** **	**0.1572**	**2.1609**	**0.0307**
EAST_SOUTH_CENTRAL	0.3729	0.2692	1.38512	0.1660
WEST_SOUTH_CENTRAL	**0.4612** **	**0.2054**	**2.2457**	**0.0247**
MOUNTAIN	-0.0183	0.1835	-0.0996	0.9206
SOR_SOCIAL_MEDIA	0.2460	0.2672	0.9208	0.3571
SOR_FRIENDS_FAMILY	0.1897	0.1252	1.5152	0.1297
SOR_INTERNET	-0.0438	0.2399	-0.1825	0.8552
SOR_CONV_MEDIA	**0.2563***	**0.1452**	**1.7649**	**0.0776**
SOR_PACKAGE_LABELS	-0.0131	0.1044	-0.1252	0.9004
SOR_PAST_EXPERIENCE	**0.2692** **	**0.1053**	**2.5557**	**0.0106**
SOR_RECIPES	**0.5597*** **	**0.1210**	**4.6249**	**0.0000**
GROCERY_STORES	**0.7941*** **	**0.1168**	**6.7987**	**0.0000**
SUPERCENTERS	**0.5080*** **	**0.1002**	**5.0705**	**0.0000**
CONVENIENCE_STORES	0.0012	0.1362	0.0088	0.9930

Table 7. (cont)

Variable*	Coefficient	Std. Error	z-Statistic	Prob.
C				
FARMER_DIRECT	**0.3482****	**0.1601**	**2.1755**	**0.0296**
ONLINE_PURCH_TREE_NUTS	0.0383	0.1542	0.2480	0.8041
OTHER_STORES	0.1083	0.1582	0.6847	0.4935
McFadden R-squared	**0.2368**			
LR statistic	**299.2499**			
Prob (LR statistic)	**0.0000**			
Observations with dep = 0	330	Total observations		994
Observations with dep = 1	664			

Reference category for gender: female
Reference category for race: other (F-statistic 1.53; p-value 0.2051)
Reference category for ethnicity: non-Hispanic
Reference category for age: age 18 to 24 (F-statistic 6.53; p-value 0.0000)
Reference category for region: Pacific (F-statistic 1.82; p-value 0.0704)

Variables with statistically significant coefficients are marked in bold; single, double, and triple asterisks (, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels.
Source: Estimation of the probit model done using IHS Global, Inc.'s (2020) EVIEWS econometrics software package.

Variance inflation factors, condition indices, and variance proportions were used to examine potential collinearity issues in the probit model (Belsley, Kuh, and Welsch, 1980). No degrading collinearity issues were evident from this examination.

All variables with estimated coefficients statistically different from zero are in bold in Table 7, either at the 10%, 5%, or 1% significance levels. Drivers associated with the decision to purchase pecans are: (i) age; (ii) region; (iii) source of information about tree nuts; and (iv) outlets where tree nuts are purchased. Neither household size, number of children, race, gender, education nor ethnicity are factors that significantly affect the decision to purchase pecans.

Older respondents aged 45 to 54, 55 to 64, and 65 and over are more likely to purchase pecans relative to younger respondents. Finally, respondents located in the West North Central, South Atlantic, and West South-Central regions are more likely to purchase pecans than respondents located in the New England, Mid-Atlantic, East North Central, East South Central, and Pacific regions of the United States.

The sources of information about tree nuts that significantly impact the decision to purchase pecans are conventional media (radio, television, or magazines), past experience, and recipes. Information about tree nuts available from social media, family and friends, the internet, and package labels does not significantly impact the decision to purchase pecans.

Purchases of tree nuts from grocery stores, supercenters, and roadside stands or farmers' markets are positively related to the decision to purchase pecans. Purchases of tree nuts from convenience

stores, online sources, or other stores (specialty stores, mall kiosks, drugstores, or discount stores) do not significantly impact the decision to purchase pecans.

Marginal effects provide insight about how changes in the righthand side variables affect the probability of purchasing pecans. To calculate the marginal effect for any explanatory variable, the estimated coefficient associated with that variable is multiplied by the standard normal density function $f(\boldsymbol{x}_i'\boldsymbol{\beta})$. The marginal effects in Table 8 were calculated at the sample means for each of the explanatory variables in the probit model. Only marginal effects of those explanatory factors whose estimated coefficients are significantly different from zero are discussed.

Relative to household heads who are between 18 and 24 years of age, the likelihood of purchasing pecans is higher by16.2%for those in the 45 to 54 age bracket; 28.6% higher for those aged 55 to 64; and 27.2% higher for those 65 years of age and over. Relative to respondents located in the Pacific region, the probability of purchasing pecans is higher by 15.2% for those located in the West North Central region; 11.7% higher for those located in the South Atlantic region; and 15.9% higher for those located in the West South Central region.

The likelihood of purchasing pecans is higher by 8.8% if conventional media is the source of information about tree nuts; higher by 9.3% if past experience is the source of information about tree nuts; and higher by 19.3% if recipes are the source of information about tree nuts. The likelihood of purchasing pecans is higher by 27.4% if tree nuts are purchased at grocery stores; higher by 17.5% if tree nuts are purchased at supercenters; and higher by 12% if tree nuts are purchased at roadside stands or farmers' markets.

About 67% of the survey respondents purchased pecans (664 out of 994 respondents). Hence, in the derivation of the prediction-success (see Table 9), the cutoff probability for classification purposes is 0.668008. That is, we predict that the *ith* reference person will purchase pecans if the probability of doing so exceeds 0.668008 and will not purchase pecans if the probability of doing so is less than 0.668008. In agreement with Greene (2012, p. 658), "in general any prediction rule will make two types of errors; it will incorrectly classify zeros as 1s and 1s as zeros." Within sample, the probit model correctly classifies the decision to not make purchases of pecans with 70.6% accuracy (233 out of 330). Within sample, the probit model correctly classifies the decision to make purchases of pecans with 74.3% accuracy (493 out of 664). Overall, within sample, the model correctly classifies all decisions 726 out of 994 times, with 73% accuracy. For binary choice models, to the best of our knowledge, no benchmark exists regarding correct classifications. The probit model composed of sociodemographic factors, sources of information about tree nuts, and where tree nuts are purchased can discern the decision to purchase as well as not to purchase pecans. Overall, the model provides correct classifications 73 out of 100 times.

Table 8. Marginal Effects Associated with the Probit Analysis Calculated at the Sample Means of the Data

Variable	Marginal Effects
HOUSEHOLD_SIZE	0.0183
NUMBER_CHILDREN	-0.0323
MALE	0.0291
BLACK	0.0241
ASIAN	-0.1756
WHITE	-0.0858
HISPANIC	0.0253
COLLEGE	0.0276
AGE_25TO34	0.0554
AGE_35TO44	0.0548
AGE_45TO54	**0.1618**
AGE_55TO64	**0.2858**
AGE_65PLUS	**0.2723**
HINCOME	0.0000[a]
NEW_ENGLAND	0.0559
MID_ATLANTIC	-0.0096
EAST_NORTH_CENTRAL	0.0232
WEST_NORTH_CENTRAL	**0.1516**
SOUTH_ATLANTIC	**0.1171**
EAST_SOUTH_CENTRAL	0.1286
WEST_SOUTH_CENTRAL	**0.1590**
MOUNTAIN	-0.0063
SOR_SOCIAL_MEDIA	0.0848
SOR_FRIENDS_FAMILY	0.0654
SOR_INTERNET	-0.0151
SOR_CONV_MEDIA	**0.0883**
SOR_PACKAGE_LABELS	-0.0045
SOR_PAST_EXPERIENCE	**0.0928**
SOR_RECIPES	**0.1930**
GROCERY_STORES	**0.2737**
SUPERCENTERS	**0.1751**
CONVENIENCE_STORES	0.0004
FARMER_DIRECT	**0.1200**
ONLINE_PURCH_TREE_NUTS	0.0132
OTHER_STORES	0.0373

[a]The marginal effect for income was estimated to be 2.33E-007.
Bold indicates marginal effects of those explanatory variables whose estimated coefficients are significantly different from zero.
Source: Calculations by the authors

Table 9. Expectation-Prediction Evaluation of the Probit Model within Sample*

	Dep = 0	Dep = 1	Total
P(Dep = 1) < = C	233	171	404
P(Dep = 1) > C	97	493	590
Total	330	664	994
Correct	233	493	726
% Correct	70.61	74.25	73.04

*Success cutoff: C = 0.668008
Dep = 0 indicates non-purchase of pecans; Dep = 1 indicates purchase of pecans.
Source: Calculations by the authors

Concluding Remarks

The main conclusions from the nationally representative consumer survey conducted in December 2020 are: (i) close to 9 out of 10 households purchase tree nuts; (ii) 2 out of 3 households purchase pecans; (iii) pecans ranked fourth in regard to favorite, second favorite, or third favorite tree nut; (iv) almost a quarter of respondents who purchase tree nuts do not purchase pecans; (v) the most common frequency of pecan purchases is annually; (vi) the primary reason for non-purchases of pecans is non-preference for pecans, but cost/budgetary restrictions, dietary restrictions, and allergies to pecans are also frequently cited as reasons for non-purchases; (vii) roughly 4 out of 5 respondents purchase pecans at grocery stores, and nearly half purchase pecans at supercenters; (viii) walnuts by far are the most popular substitute for pecans; (ix) principal pecan perceptions that come to mind include ingredient for cooking or pies, delicious/tasty desserts, family/holiday gatherings and memories, wholesome, snacks, heart-healthy/heart-smart, expensive, nutrition powerhouse, high caloric content, homegrown, and Texas/southern states; (x) slightly more than 60% of respondents do not recall seeing or hearing messages that would encourage them to purchase pecans; (xi) the predominant source of messaging concerning pecans comes from recipes; (xii) slightly more than 40% of respondents revealed that lowering the price would make them more likely to purchase more pecans, while nearly 30% placed emphasis on health and nutrition considerations in purchasing pecans; and (xiii) close to 8% said nothing would make them more likely to purchase more pecans, and about 20% did not know what would make them more likely to purchase more pecans.

Based on the survey data collected using SurveyMonkey, a probit model was estimated incorporating sociodemographic variables, sources of information about tree nuts, and where tree nuts are purchased as explanatory variables. Drivers associated with the decision to purchase pecans are: (i) age; (ii) region; (iii) source of information about tree nuts; and (iv) outlets where tree nuts are purchased. Neither household size, number of children, race, gender, education, nor ethnicity are factors that significantly affect the decision to purchase pecans.

Older respondents aged 45 to 54, 55 to 64, and 65 and over are more likely to purchase pecans relative to younger respondents. Finally, respondents located in the West North Central, South Atlantic, and West South Central regions are more likely to purchase pecans than respondents

located in the New England, mid-Atlantic, East North Central, East South Central, Mountain, and Pacific regions.

The sources of information about tree nuts that significantly impact the decision to purchase pecans are conventional media (radio, television, or magazines), past experience, and recipes. Information about tree nuts available through social media, family and friends the internet, and package labels does not significantly impact the decision to purchase pecans. Purchases of tree nuts from grocery stores, supercenters, and roadside stands or farmers' markets are positively related to the decision to purchase pecans. Purchases of tree nuts from convenience stores, online sources, specialty stores, mall kiosks, drugstores, or discount stores do not significantly impact the decision to purchase pecans.

The bottom line is that on the basis of the survey sample used in this study, the primary targets for American Pecan Council promotion are older households residing in the West North Central, South Atlantic, and West South Central regions of the United States. Additionally, households who rely on radio, television, or magazines, past experience, and recipes with tree nuts, and households who purchase tree nuts at grocery stores, supercenters, roadside stands, or farmers' markets also are targets for the American Pecan Council. These results should help stakeholders in the pecan industry increase sales by targeting households that are more likely to purchase pecans. This research provides a benchmark for future studies concerning the decision to purchase pecans. We have answered a question that has not been addressed previously, namely, what sociodemographic factors, sources of information about tree nuts, and outlets where tree nuts are purchased affect the decision to purchase pecans in the United States.

Moreover, information contained in various recent snack food and grocery trade publications indicates substantial growth in consumption of salty snacks, particularly among the millennial demographic. Given the predominant end use of pecans (and walnuts) in baked goods rather than salty snacks, the case can be made that the pecan industry should aggressively expand its product market to salty snack products and their target consumers in age cohorts younger than 45.

Future research using scanner data and other quantitative demand metrics would be valuable to validate these findings. As well, this work can be expanded to include a probit analysis for tree nuts in general, not necessarily specific to pecans. Moreover, a multivariate choice model analysis could be done dealing with the frequency of pecan purchases (none at all, weekly, monthly, annually, and only during holidays). Also, multivariate discrete choice models could be developed centering attention on the favorite type of tree nut purchased.

Limitations of the study include the absence of data on the quantity of tree nuts purchased. As such, no estimates of own-price, cross-price, and income elasticities are provided. Nevertheless, this study provides information for marketing strategies to the American Pecan Council as well as other stakeholders in the tree nut industry.

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Data Availability

All data associated with this work are available from the authors upon request. These data were obtained via the construction and administration of a nationally represented online consumer survey to a panel of U.S. residents using SurveyMonkey (https://www.surveymonkey.com/), a well-known online survey software application.

Competing Interest

All authors have contributed to this article.

References

Alviola, P.A., and O. Capps, Jr. 2010. "Household Demand Analysis of Organic and Conventional Fluid Milk in the United States Based on the 2004 Nielsen Homescan Panel." *Agribusiness: An International Journal* 26(3):369–388.

Asci, S., and S. Devadoss. 2021. "Trends and Issues Relevant for the U.S. Tree Nut Sector." *Choices* 36(2):1–7.

Belsley, D.A., K. Kuh, and R.E. Welsch. 1980. *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*. New York: John Wiley & Sons.

Blomhoff, R., M.H. Carlsen, L.F. Andersen, and D.R. Jacobs, Jr. 2006. "Health Benefits of Nuts: Potential Role of Antioxidants." *British Journal of Nutrition* 96(supplement 2):S52–S60.

Byrne, P.J., O. Capps, Jr., and A. Saha. 1996. "Analysis of Food-Away-From-Home Expenditure Patterns for U.S. Households 1982-1989." *American Journal of Agricultural Economics* 78(3):614–627.

Capps, Jr., O., A. Ahad, and P.S. Murano. 2017. "Understanding Spending Habits and Buying Behavior of the American Muslim Community: A Pilot Study." *Journal of Food Distribution Research* 48(3):51–74.

Capps, Jr., O., and R.A. Kramer. 1985. "Analysis of Food Stamp Participation Using Qualitative Choice Models." *American Journal of Agricultural Economics* 67(1):49–59.

Cheng, G., O. Capps, Jr., and S. Dharmasena. 2021. "Demand Analysis of Peanuts and Tree Nuts in the United States: A Micro-Perspective." *International Food and Agribusiness Management Review* 24(3):523–544.

Dharmasena, S., and O. Capps, Jr. 2014. "Unraveling Demand for Dairy-Alternative Beverages in the United States: The Case of Soymilk." *Agricultural and Resource Economics Review* 43(1):140–157.

Florkowski, W.J., and T.A. Park. 2001. "Promotional Programmes and Consumer Purchasing Decisions: Pecan Demand Models." *Applied Economics* 33(6):763–770.

Fraser, G.E., J. Sabate, W.L. Beeson, and T.M. Strahan. 1992. "A Possible Protective Effect of Nut Consumption on Risk of Coronary Heart Disease: The Adventist Health Study." *Archives of Internal Medicine* 152(7):1416–1424.

Gold, M., M.M. Cernusca, and L. Godsey. 2004. "Consumer Preferences for Chestnuts, Eastern Black Walnuts, and Pecans." *HortTechnology* 14(4):583–589.

Greene, W.H. 2012. *Econometric Analysis*, 7th ed. New York: Pearson.

Hanushek, J., and E. Jackson. 1977. *Statistical Methods for Social Scientists*. New York: Academic Press.

Hill, H., and F. Lynchehaun. 2002. "Organic Milk: Attitudes and Consumption Patterns." *British Food Journal* 104(7):526–542.

IHS Global Inc. 2020. *EVIEWS*, version 11. Available online: https://www.eviews.com.

King, J.C., J. Blumberg, L. Ingwersen, M. Jenab, and K.L. Tucker. 2008. "Tree Nuts and Peanuts as Components of a Healthy Diet." *The Journal of Nutrition* 138(9):1736S–1740S.

Kris-Etherton, P.M., F.B. Hu, E. Ros, and J. Sabaté. 2008. "The Role of Tree Nuts and Peanuts in the Prevention of Coronary Heart Disease: Multiple Potential Mechanisms." *The Journal of Nutrition* 138(9):1746S–1751S.

Lillywhite, J.M., J.E. Simonsen, and R.J. Heerema. 2014. "U.S. Consumer Purchases and Nutritional Knowledge of Pecans." *HortTechnology* 24(2):222–230.

Lombardini, L., T.M. Waliczek, and J.M. Zajicek. 2008. "Consumer Knowledge of Nutritional Attributes of Pecans and Factors Affecting Purchasing Behavior." *HortTechnology* 18(3):481–488.

Maddala, G.S. 1983. *Limited Dependent and Qualitative Variables in Econometrics.* Cambridge, United Kingdom: Cambridge University Press.

Mattes, R.D., P.M. Kris-Etherton, and G.D. Foster. 2008. "Impact of Peanuts and Tree Nuts on Body Weight and Healthy Weight Loss in Adults." *The Journal of Nutrition* 138(9):1741S–1745S.

McFadden, D. 1984. "Econometric Analysis of Qualitative Response Models." In Z. Griliches and M. Intriligator, eds. *Handbook of Econometrics* 2:1395–1457.

Pawlak, R., S. Colby, and J. Herring. 2009. "Beliefs, Benefits, Barriers, Attitude, Intake and Knowledge about Peanuts and Tree Nuts among WIC Participants in Eastern North Carolina." *Nutrition Research and Practice* 3(3):220–225.

Pindyck, R.S., and D.L. Rubinfield. 1998. *Econometric Models and Economic Forecasts,* 4th ed. New York: McGraw-Hill.

Ros, E. 2010. "Health Benefits of Nut Consumption." *Nutrients* 2(7):652–682.

Statista. 2020. *Statista.* Available online: www.statista.com [Accessed December 2020].

SurveyMonkey 2020. *SurveyMonkey.* Available online: https://www.surveymonkey.com/.

U.S. Census Bureau. 2020. *Current Population Survey (CPS)*. Available online: https://www.census.gov/main/www/cprs.html.

U.S. Department of Agriculture. 2022. *Fruit and Tree Nuts Yearbook Tables.* Washington, DC: Economic Research Service. Available online: https://www.ers.usda.gov/data-products/fruit-and-tree-nuts-data/fruit-and-tree-nuts-yearbook-tables/#Tree%20Nuts.

U.S. Department of Agriculture and U.S. Department of Health and Human Services. 2020. *Dietary Guidelines for Americans, 2020-2025*, 9th ed. Available online: https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf.

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The Changing Role of Fat Perceptions in Fluid Milk Labeling: Would the Dairy Industry Sell More if 2% Milk Was Called "98% Fat Free"?

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Abstract

U.S. consumers' perceptions of fat content in food may have changed substantially over the past few decades. This is particularly relevant for the dairy industry as fluid milk is marketed with many different fat content options. Using a stated preferences contingent valuation experiment, this article explores consequences of framing effects of fat on the fluid milk label. Specifically, we investigate whether using alternative but equivalent labels of 96.75% fat free, 98% fat free and 99.98% fat free, whole, 2% fat, and skim milk change consumer willingness to pay. Results indicate that such framing effects rarely have the intended effect and that consumers would actually pay *less* for 2% fat milk if it were called 98% fat-free milk.

Keywords: willingness to pay, consumer behavior, fluid milk fat preferences

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Introduction

For over a century, policy makers have focused on the importance of food packaging and labeling. Indeed, the way information is presented matters, as design, color choice, use and placement of labels, and symbols and icons on food packages all contribute to consumer perceptions (Cavanagh, Kruja, and Forestell 2014; Newman, Howlett, and Burton, 2014; Becker et al., 2015; Cho and Baskin, 2018; Goodman et al., 2018; Roseman, Joung, and Littlejohn, 2018; Muller, Lacroix, and Ruffieux, 2019; Garber, Burke, and Jones, 2000). Health outcomes are of particular importance to policy makers as health policy has been a focus of food policy for decades. One such policy focus area has been fat consumption. During the past 50 years, the heath impacts of fat consumption have been heavily discussed in both scientific literature and media. Initially, higher consumption was linked to health problems in a straightforward way, and limited intake of fat was recommended. More recently, however, those direct links have been challenged. It is possible that the well-established narrative of "fat is bad for health" still influences consumers and their purchasing decisions. But it is also possible that the challenge to the narrative has induced a change in consumer attitudes toward fat consumption.

This study focuses on the framing effects of consumers' perceptions of fat content in fluid milk. Liquid milk is recognized as a source of fat, and fat content is a key attribute consumers reference when choosing milk (Harwood and Drake, 2018). Prior studies have documented the impact of "framing" (the way information is presented) and "nudges" (interventions designed to influence consumer behavior) on consumer behavior within a variety of contexts, though few studies have focused on framing effects of milk fat. We seek to fill that gap in the literature by exploring whether reframing milk fat labels might alter consumer demand for fluid milk products.

We contribute to the literature in three ways. Specifically, our objectives are to (i) find out if a reframing of milk fat content ("fat content" versus "fat-*free* content") changes consumer willingness to pay (WTP) for fluid milk, (ii) identify other factors that influence consumer WTP when framing effect is present, and (iii) draw on the results to infer consequences for the producers and sellers of fluid milk. To accomplish these objectives, we analyze data collected from a web-based survey where primary shoppers from 883 U.S. households answered questions about their willingness to pay for a half-gallon of milk. These types were labelled as 2% reduced-fat milk, vitamin D whole milk, skim milk, 98% fat-free milk, 96.75% fat-free milk, and 99.8% fat-free milk. We also explore the moderating effects of consumer demographics and dietary habits as they relate to consumer willingness to pay for these milk varieties.

Background

The FDA regularly updates food label regulations to better reflect the best available health and food safety research (NPD, 2020). In the 1970s, the Senate Select Committee on Nutrition and Human Needs released "Dietary Goals for the United States," seeking to promote healthy diets and reduce prevalent diet-related diseases. Based on the best scientific knowledge available at the time, the dietary goals made certain nutrition recommendations. As an example, influential studies such as Keys et al. (1986) suggested dietary fat and cholesterol were strongly correlated with heart

attacks. In response, reducing overall fat and saturated fat consumption (dairy, eggs, red meat) along with consuming a balance of polyunsaturated and monounsaturated fats (fish, fruits, and vegetables) was recommended. Whole milk fat content is more than 60% saturated fat, so the Committee suggested replacing it with low-fat milk types. Other suggestions included attaining about 50% of total energy intake from consuming complex carbohydrates and "naturally occurring" sugar. Since 1980, the U.S. Department of Agriculture and the Department of Health and Human Services have been jointly publishing *Dietary Guidelines for Americans* in 5-year intervals.

More recently, the direct link between fat consumption and human health has been called into question. For example, a meta-analysis failed to find a correlation between saturated fat and cardiovascular diseases (Siri-Tarino et al., 2010). Evidence of an association between whole-fat dairy and cardiovascular disease, obesity, and diabetes is inconsistent (Mozaffarian, 2016). The 2015 Dietary Guidelines reflected the evolving science, dropping fat as a "nutrient of concern" and imposing no upper limit on total fat consumption, but still recommended keeping saturated fat intake within less than 10% of total calorie intake (Astrup et al., 2020).

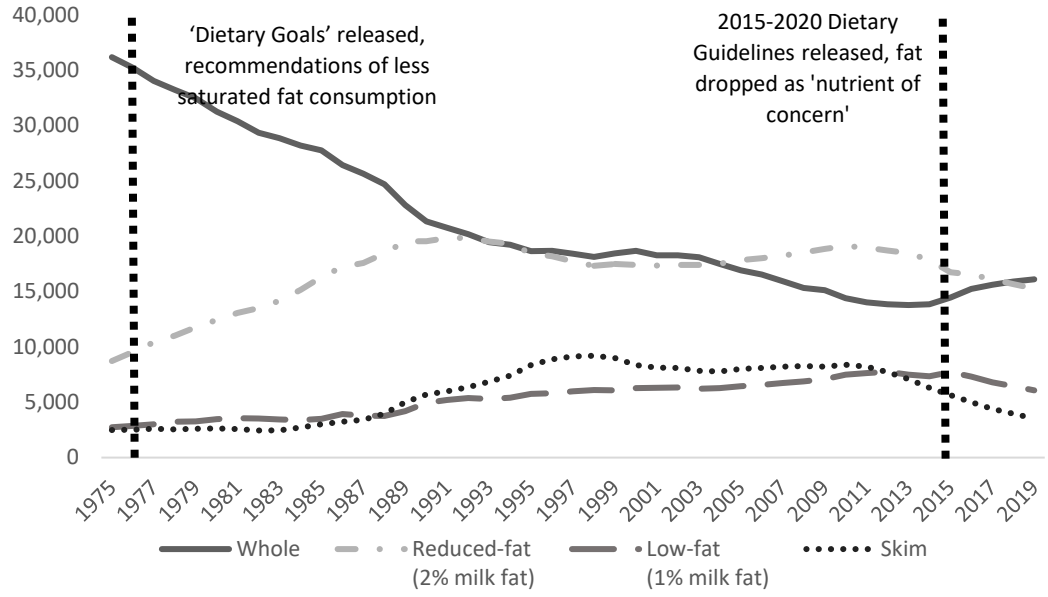
Indeed, the scientific consensus regarding the link between fat and health risks has changed relative to the prior decades. Lower-fat food used to be promoted heavily to be unambiguously health beneficial by the federal government, public health institutions, the food industry, and popular media (La Berge, 2008), but the modern debate has led to front-page popular press articles with titles such as "Eat Butter. Scientists Labeled Fat the Enemy. Why They Were Wrong" (Walsh, 2014), "How the Sugar Industry Shifted Blame to Fat" (O'Connor 2016), and "For decades, the Government Steered Millions Away from Whole Milk. Was That Wrong?" (Whoriskey, 2015).

Fluid Milk Consumption Trends

Demand shifts over time often reflect changes in consumer preferences. While overall per capita consumption of dairy products in the United States has been rising, categories of dairy products have followed different trends. Per capita cheese and butter consumption continues to rise, and yogurt sales witnessed a sharp upward incline in the 2000s. In contrast, aggregate fluid milk consumption has been declining over nearly the last 50 years (USDA-ERS, 2020). Figure 1 presents changes in annual U.S. fluid milk sales broken down by product.

Total sales of fluid milk continue to trend downward, but not all varieties are in decline. Between 2010–2015, trends in whole-milk, 2% milk, and skim milk sales seem to have reversed compared to prior years. Skim milk sales peaked in 1998 and have now decreased to nearly 1975 levels.

Meanwhile, following decades of decline, aggregate whole milk consumption has increased each year since 2013 with 2019 being 17% higher than 6 years earlier. In 2018, whole milk passed 2% (reduced-fat) milk as the largest milkfat category consumed.



Source: (USDA-ERS 2020)

Figure 1. Fluid Beverage Milk Sales Quantities by Product (millions of pounds), 1975–2019

Why the dramatic shift? Fluid milk consumption trends have been much discussed and dissected in the academic literature with both domestic and international policy implications (Vitaliano 2016). Possible—though incomplete—explanations range from generational shifts in preferences (Stewart, Dong, and Carlson, 2013) to increasing demand for plant-based alternatives (Wolf, Malone, and McFadden, 2020).

Despite the downward trend in fluid milk sales, the consumption of butter and cheese has risen 177% and 23% between 1975 and 2018 (USDA-ERS, 2020). While the increase in cheese consumption reflects the increased popularity of home-delivery options for food such as pizza, the increase in butter has mostly happened since 2010 (Wolf, Malone, and McFadden, 2020). Indeed, the changing consumer dynamic of milk beverage preferences with the backdrop of possible alteration in public health views regarding fat provides an interesting context for a deeper investigation into consumer motivations.

Framing Effects and Behavioral Nudges

Framing effects are decision biases that occur when objectively equivalent information is presented in different references, often from either positive or negative terms (Denburg and Hedgcock, 2015). Closely related to framing effects is the idea of behavioral "nudge," described as "any aspect of the choice architecture that alters people's behavior in subtle but predictable ways without forbidding any options or significantly changing their economic incentives." (Thaler and Sunstein, 2008, p. 6). These concepts combined demonstrate the effects of changes in the presentation of information while not changing the information itself.

Using different terms for the same product has been consistently shown to evoke different consumer attitudes (Bryant and Barnett, 2019). This concept has become particularly appealing to the food marketing literature as nudges can invoke healthier eating behavior in consumers (Vecchio and Cavallo, 2019). Simple changes on a product label can allow marketers and policy makers to induce changes to the nutritional profile of a consumer's plate (Just and Gabrielyan, 2016; Matjasko et al., 2016; Roberto and Kawachi, 2014). Consumers may choose healthier options or reduce their portion sizes based on how the product information is framed (Roseman, Joung, and Littlejohn, 2018; Alcantara et al., 2020) .

The food marketing literature is full of framing effects. Prior studies have found that framing a giveaway as "free" is a more effective marketing strategy than advertising the product as "Get it for $0" (Koo and Suk, 2020). Loss-framed messages (highlighting a forgone chance of reducing infection by not consuming intervention-treated cattle beef) induced a higher WTP for food safety technologies in beef purchases than gain-framed messages (highlighting the chance of avoiding infection by consuming intervention-treated beef) (Britwum and Yiannaka, 2019). Consumers are more open to purchasing raw milk if the frame presenting it resonates with them (Rahn, Gollust, and Tang, 2017). More closely related to the current research, researchers have explored the moderating effects of educational messaging on WTP for skim and 2% milk varieties under "Certified Fresh Taste" labeling despite the inability to sense a difference in the milk product (Paterson and Clark, 2020).

Methods

Given the highlighted change in health perceptions of fat consumption along with the prior literature on framing effects in food marketing, this study hypothesizes that presenting "fat" versus "fat-free" framing of liquid milk labels will influence consumers in believing the health considerations of the purchase and nudge them toward making a more health-conscious decision while buying milk.

We seek to explore whether WTP for fluid milk might be affected by the framing of fat content on a product label. We anticipate that consumers should at least be willing to pay the same, if not more, for a milk product with a label that implies that the the same product is healthier. To test this hypothesis, our experiment reframes fluid milk labels. For example, in one frame, fat content is presented in the common reduced-fat manner (e.g., "2% fat"). An alternative frame is also presented that represents the same fat content as "98% fat free." If consumers see higher fat content milk as healthier, everything else remaining equal, we would not see consumers willing to pay more for "fat-free" frames. We use paired t-tests to compare differences in WTP between the two alternatives.

Our study utilizes a between-subjects survey experiment with 883 respondents. The survey was first piloted with 131 participants via Amazon Mechanical Turk (MTurk) in October 2018. After adjusting the survey, the experiment was then conducted with a follow-up group of 74 participants on March 13, 2019. The final experiment was carried out from March 18 to March 25, 2019, and data were collected via a panel of participants from across the United States provided by the

professional sampling company SSI-Dynata. Participants were paid the equivalent of approximately $1.50 in incentives, such as cash, airline miles, and gift cards to complete the survey. Descriptive characteristics of the sample are shown in the Table 1, where they are contrasted with corresponding 2019 America Community Survey data from the U.S. census (U.S. Census Bureau, 2020).

Table 1. Sample Characteristics

Variable	Category Levels	Sample	2019 Census
		%	%
Gender	Female	60.8	50.8
Ethnicity	White	57.2	60.1
	Black or African American	20.2	13.4
	Hispanic, Latino, or Spanish	12.1	18.5
	American Indian or Alaskan Native	0.1	1.3
	Asian or Pacific Islander	7.4	6.1
	Other	3.1	0.6
Education	High school/GED or less	23.6	38.0
	Some college	23.7	15.6
	2-year college degree (associate's)	11.7	10.4
	4-year college degree (BA/BS)	27.8	22.6
	Advanced degree (MS, PhD, JD)	13.4	13.4
Household income	Less than $20,000	19.7	13.1
	$20,000–$39,999	24.4	15.9
	$40,000–$59,999	19.1	15.3
	$60,000–$79,999	15.9	12.1
	$80,000–$99,999	9.5	9.5
	$100,000–$119,999	4.0	7.6
	$120,000–$159,999	4.0	10.3
	$160,000 or greater	3.5	16.3
Children under 12 years old in household	Yes	22.3	N/A
	No	77.7	
On a diet	Yes	16.1	
	Maybe	11.3	N/A
	No	72.6	

Number of participants: 883

More than half the participants identified as Caucasian, and more than half identified as female. Most made annual incomes under $80,000 and did not have children under age 12 in the household. About 28% of the participants had completed a 4-year college degree and few indicated being on a diet. Females, African Americans, and college-educated consumers were oversampled relative to the U.S. census (Smith et al., 2016). It is important to note, however, that our sample frame primarily focused on primary food shoppers of U.S. households, so it is reasonable to anticipate some differences between the census and our participants.

Participants answered 1.5 bounded contingent valuation questions. Contingent Valuation (CV) is a common approach to stated preference modeling and commonly applied via survey to elicit consumer-placed values on goods, services, and amenities where revealed preference approaches are not feasible (Boyle, 2003). We opted to utilize the CV approach as opposed to other approaches, such as a discrete choice experiment, to reduce the length of the online survey, as prior studies have indicated issues with measurement error as the survey instrument increases in length and complexity (Malone and Lusk, 2018a, 2018b, 2019). In the current context, this method provides estimated values that consumers are willing to pay for liquid milk products under hypothetical labels. A dichotomous choice question in CV asks individuals whether they are willing to pay a certain amount for a specific good. A one-and-a-half bounded CV question includes one dichotomous choice question and follow-up "payment card" question, which gives a range for possible amounts individuals would be willing to pay and lets them choose from that range.

Figure 2 presents an example of one of the CV questions asked of survey respondents. Each participant provided their WTP for two randomly assigned half-gallons of milk from two equivalent sets of three. Set 1 included milk labels generally used: 2% reduced-fat milk, Vitamin D whole milk, and skim milk. Set 2 included milk labels in "% fat free" format to highlight their health attribute: 98% fat-free milk, 96.75% fat-free milk, and 99.8% fat-free milk. This resulted in (2 x 883) = 1,766 WTP observations. We use OLS estimation and t-tests to compare the respondents' WTP for the same half-gallons of milk that are labeled differently.

We estimate three models. First, we compare WTP across the six different milk categories. The statistical model is specified as:

$$WTP_n = \sum_i \beta_i^M \cdot Milk_{i,n} + \mu_{n,} \quad (1)$$

where WTP_n is the n participants' WTP for i^{th} category of milk, $Milk_{i,n}$ is the indicator variable of type of milk the respondent is pricing and μ_n is the statistical error term assumed $iid \sim N(0, \sigma)$. i represents the set of milk varieties inclusive of {2% Reduced Fat, 98% Fat Free, Vitamin D whole, 96.75% fat free, skim, and 99.8% fat free}.

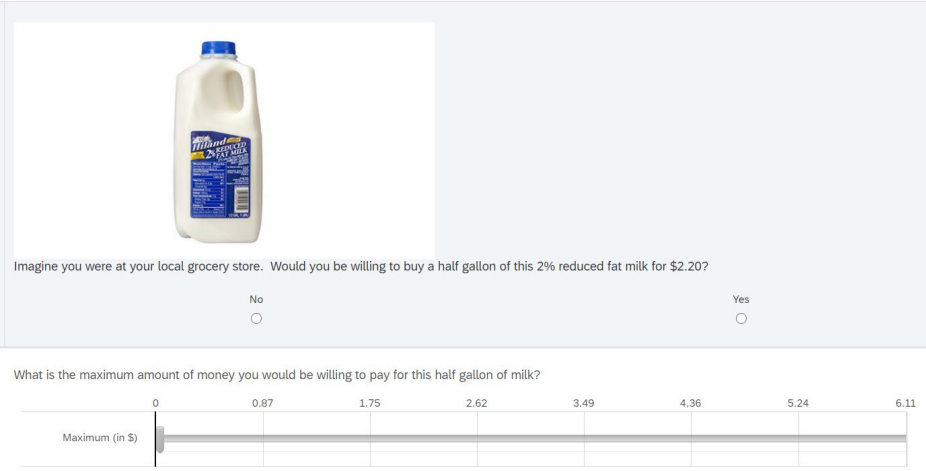


Figure 2. Sample Contingent Valuation Question

We anticipate that several other external factors might impact effect size. In the marketing literature, influencing factors are often referred to as moderating and mediating effects, depending on how they influence the final consumer response (Zanoli et al., 2015). Previous dairy research on nudging and framing effects have suggested that moderating factors might alter consumer preferences (Jung et al., 2017). In this case, education levels should reduce the impact of framing effects on WTP but may be associated with expansive effect size through the relationship between education and healthy food choice (Rothman et al., 2006). We also anticipate that income levels will expand effect size, as higher income consumers will exhibit higher WTP for desired attributes. Health-related restrictions in consumer diets is also likely to be relevant for consumer WTP across the different varieties and associated implied health attributes.

We estimate effect size in stages where moderating effects are added sequentially to a main effects model. For generality, we drop observation subscripts, n, in our subsequent model depictions. Starting with the model of main effects, the statistical model is specified as:

$$WTP = Constant + \sum_i \beta_i^M \cdot Milk_i + \beta_0^F \cdot Female + \beta_0^C \cdot Children +$$

$$\sum_r \beta_r^R \cdot Race_r + \beta_0^E \cdot College + \beta_0^I \cdot Inc + \beta_0^D \cdot Diet + \mu, \quad (2.a)$$

where *Female* is the indicator variable taking the value 1 for Female and 0 otherwise. *Children* is the indicator variable denoting the presence of children under age 12 in the household (1 = Children; 0 = No children present). $Race_r$ is an indicator variable showing fixed effects for self-selected race category the respondent identifies. Category levels are White, Black or African American, Hispanic, Latino or Spanish, American Indian or Alaskan Native, Asian or Pacific Islander, and Other Ethnicity. *College* takes the value 1 for the respondents who completed a college degree or higher and 0 otherwise; *Inc* is a continuous representation using midpoint values of 9 income categories ranging from less than $20,000 to $160,000 and greater, measured in thousands of dollars, and *Diet* is a binomial indicator taking the value 1 if the respondent indicated being on a calorie-constrained diet at the time of the survey or zero for otherwise.

From this model, each subsequent model entails adding moderating interactions between milk categories and demographic moderators to the main effects model. Model 2.b adds interaction between $College$ and $Milk_i$ to model 2.a.

$$WTP = Constant + \sum_i \beta_i^M \cdot Milk_i + \beta_0^F \cdot Female + \beta_0^C \cdot Children +$$

$$\sum_r \beta_r^R \cdot Race_r + \beta_0^E \cdot College + \beta_0^I \cdot Inc + \beta_0^D \cdot Diet +$$

$$\sum_i \beta_i^{E,M} \cdot (College \cdot Milk_i) + \mu \quad (2.b)$$

Model 2.c adds interaction between Inc and $Milk_i$ to model 2.b.

$$WTP = Constant + \sum_i \beta_i^M \cdot Milk_i + \beta_0^F \cdot Female + \beta_0^C \cdot Children +$$

$$\sum_r \beta_r^R \cdot Race_r + \beta_0^E \cdot College + \beta_0^I \cdot Inc + \beta_0^D \cdot Diet +$$

$$\sum_i \beta_i^{E,M} \cdot (College \cdot Milk_i) + \sum_i \beta_i^{Inc,M} \cdot (Inc \cdot Milk_i) + \mu \quad (2.c)$$

Model 2.d adds interaction between $Diet$ and $Milk_i$ to model 2.c.

$$WTP = Constant + \sum_i \beta_i^M \cdot Milk_i + \beta_0^F \cdot Female + \beta_0^C \cdot Children +$$

$$\sum_r \beta_r^R \cdot Race_r + \beta_0^E \cdot College + \beta_0^I \cdot Inc + \beta_0^D \cdot Diet +$$

$$\sum_i \beta_i^{E,M} \cdot (College \cdot Milk_i) + \sum_i \beta_i^{Inc,M} \cdot (Inc \cdot Milk_i) +$$

$$\sum_i \beta_i^{D,M} \cdot (Diet \cdot iMilk_i) + \mu \quad (2.d)$$

Akaike information criterion (AIC) model fit statistics are used to compare model specifications.

Because the frequency with which one consumes milk will likely have implications on their familiarity with beverage milk options and WTP, another model was specified that accounts for consumption frequency. We hypothesize that participants who consume milk less frequently might be more susceptible to nudge bias from framing effects. In this final model (Model 3), we control for consumption frequency (CFreq) of 2%, Vitamin D Whole, and Skim milk along with interaction effects to look for possible moderating effects. As in model 3.a, we only have the main effects while model 3.b. adds the interaction effects.

$$WTP = Constant + \sum_i \beta_i^M \cdot Milk_i + \sum_k \beta_k^{CR} \cdot CFreq_k + \mu \quad (3.a)$$

and

$$WTP = Constant + \sum_i \beta_i^M \cdot Milk_i + \sum_k \beta_k^{CR} \cdot CFreq_k +$$

$$\sum_k \sum_i \beta_{i,k}^{CR,M} \cdot (CFreq_k \cdot Milk_i) + \mu \quad (3.b)$$

Here, *CFreq* is a variable indicating consumption of milk type *k* with four categorical levels: 1 = *Regular part of my diet*, 2 = *Consume, but not on a regular basis*, 3 = *Limit my consumption,* and 4 = *Don't consume at all*. For parsimony, we treat the variable as continuous.

Results

Table 2 shows the simple differences in WTP across the six milk labels where the first column displays mean WTP and standard errors. The lower diagonal shows the level of statistical significance between the corresponding pairs. Skim Milk and 99.8% Fat-Free Milk labels generated lower WTP than 2% Fat and Whole Milk labels. Willingness to pay estimates indicate that average WTP for 2% Fat and Whole Milk are consistent. That said, while WTP for 2% Fat and Whole Milk are not statistically different, consumers perceive a clear delineation between 2% Fat and alternatively labeled, but equally attributable, 98% Fat Free.

Table 2. Simple Differences in Willingness to Pay (Model 1**)**

		Significance of Difference					
	Mean WTP	**2% Fat**	**98% Fat free**	**Whole Milk**	**Skim**	**96.75% Fat free**	**99.8% Fat Free**
2% fat	$2.27 (0.052)						
98% fat free	$2.08 (0.061)	**					
Whole milk	$2.29 (0.060)		**				
Skim	$2.07 (0.060)	**		***			
96.75% fat free	$2.18 (0.063)						
99.8% fat free	$2.01 (0.061)	***		***		*	

Note: Standard errors in parentheses.

Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels.

Table 3 presents our statistical analysis for Model 2, which tests for interaction effects among milk categories and demographic moderators. Model fit statistics across all models indicate that the parsimonious main effects model is preferred over the progressively complicated models. The findings show, again, that the simple reversal of the default fat content does not have substantially different impacts on consumer WTP across varieties of milk except for 2%. Model 2.a in Table 3 starts with a simple mean WTP model with the base indicated by the 2% Fat Milk label and adds control-variable main effects. The inclusion of the model main effects does not detract from differences in WTP relative to the results presented in Table 1. However, several of the main effects are significantly correlated with expected WTP. Both African American and Hispanic respondents indicated a higher WTP in general. Similarly, those indicating completion of a college degree or higher and those with higher incomes were found to have a higher WTP in general. Finally, though weakly significant, those who indicated being on a calorie-constrained diet indicated a higher WTP overall.

Table 3. Main Effects Model with Demographic Moderators (Model 2)

Independent Variable	Model 2.a	Model 2.b	Model 2.c	Model 2.c
98% Fat free	-0.175 (0.085)**	-0.108 (0.099)	-0.238 (0.146)	-0.227 (0.209)
Whole	0.021 (0.084)	0.061 (0.099)	0.097 (0.144)	0.363 (0.203)*
96.75% Fat free	-0.094 (0.083)	-0.043 (0.099)	-0.007 (0.145)	0.152 (0.210)
Skim	-0.203 (0.084)**	-0.153 (0.099)	-0.155 (0.145)	-0.080 (0.213)
99.8% Fat free	-0.265 (0.084)***	-0.246 (0.100)**	-0.175 (0.144)	0.032 (0.207)
Female	0.076 (0.051)	0.075 (0.052)	0.075 (0.052)	0.074 (0.052)
Children	0.023 (0.058)	0.026 (0.059)	0.027 (0.059)	0.025 (0.059)
African American	0.233 (0.063)***	0.231 (0.064)***	0.235* (0.064)***	0.232* (0.064)***
Hispanic	0.365 (0.076)***	0.361 (0.077)***	0.363* (0.077)	0.360* (0.077)***
American Indian	0.429 (0.720)	0.458 (0.721)	0.477 (0.721)	0.500 (0.724)
Asian/Pacific Islander	0.066 (0.097)	0.054 (0.098)	0.054 (0.098)	0.055 (0.098)
Other ethnicity	-0.165 (0.143)	-0.165 (0.143)	-0.170 (0.143)	-0.176 (0.143)
College	0.114 (0.055)**	0.248 (0.133)*	0.247 (0.135)*	0.251 (0.135)*
Inc	0.002 (0.001)***	0.002 (0.001)***	0.002 (0.002)	0.002 (0.002)
Diet	0.107 (0.057)*	0.108 (0.057)*	0.110 (0.057)*	0.274 (0.143)*
98% Fat free x college		-0.253 (0.192)	-0.297 (0.195)	-0.308 (0.195)
Whole x college		-0.138 (0.186)	-0.126 (0.189)	-0.121 (0.189)
96.75% Fat free x college		-0.175 (0.183)	-0.167 (0.185)	-0.171 (0.185)
Skim x college		-0.179 (0.189)	-0.180 (0.192)	-0.191 (0.192)
99.8% Fat free x college		-0.065 (0.187)	-0.037 (0.190)	-0.032 (0.190)
98% Fat free x inc			0.002 (0.002)	0.003 (0.002)
Whole x inc			-0.001 (0.002)	-0.001 (0.002)

Table 3. (cont)

Independent Variable	Model 2.a	Model 2.b	Model 2.c	Model 2.c
96.75% Fat free x inc			-0.001 (0.002)	-0.001 (0.002)
Skim x inc			0.000 (0.002)	0.000 (0.002)
99.8% Fat free x inc			-0.002 (0.002)	-0.001 (0.002)
98% Fat free x diet				-0.012 (0.197)
Whole x diet				-0.364 (0.194)*
96.75% Fat free x diet				-0.206 (0.197)
Skim x diet				-0.100 (0.198)
99.8% Fat free x diet				-0.274 (0.198)
Constant	1.922 (0.087)***	1.884 (0.094)***	1.878 (0.117)***	1.755 (0.154)***
AIC	5071.5	5089.3	5084.7	5088.8

Note: Standard errors in parentheses.
Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels.
Base Case: 2% milk, not female, no children under 12 in HH, Caucasian, no college/higher degree, not on a diet

The second column in Table 3 (Model 2.b) expands the main effects model by adding college education moderating effects on WTP. Not surprisingly, the college interaction variable detracts from the college variable main effects. It also reduces the significance of the base differences in WTP across milk labels. However, this model retains the overall significance of having at least a 4-year degree. Accordingly, only the fictitious 99.8% fat-free label draws a significant base differential WTP to 2% Fat. Because the interaction terms of college education by milk label do not enter the model significantly, we are left to deduce that college education does not moderate WTP across labels—even when the 2% fat label is reframed as 98% fat-free. Though we anticipated that more educated participants might be able to recognize 98% fatfree milk as equivalent to 2% Milk, the analysis does not indicate a significant effect. As such, we conclude that a college degree may not insulate one from this framing effect.

The third model (Model 2.c) adds moderating effects of income on WTP by label. Adding income interactions mitigates income main effects as expected and further erodes the base WTP differentials. Like education, income interaction effects do not appear to moderate WTP for the different labels. That is, like education, higher income households are equally susceptible to the change in milkfat framing effects.

The fourth and final model (Model 2.d) adds diet interaction effects to the model. Diet interaction effects largely do not enter the model significantly, though there appears to be a weak association with lower WTP for whole milk in dieters relative to 2% fat. This is consistent with (Liebman et al., 2001) who found an association between reduced-fat intake and dieters. This effect is also observed in the model base WTP differentials indicating that whole milk label direct effects are positive relative to the 2% fat label. That premium is offset by the *diet* x *Whole Milk* interaction.

The final model estimates main and interaction effects for the frequency of consumption of whole, 2% fat, and skim milk. The conjecture is that frequent consumption will have a positive effect on WTP overall but will eliminate the framing effect (Table 4). Model 3.a is limited to main effects, where significance of WTP differentials largely reflect those shown in Model 2.a of Table 3. However, the factor variables differ in Model 3.a below, indicating that increased frequency of consumption for all three categories have a significant and negative effect on WTP. This may indicate that individuals who do not purchase milk regularly are less susceptible to behavioral anomalies (List, 2003). Either way, the more interesting question is how frequency of consumption moderates WTP differentials across labels. As shown in Model 3.b, introducing interactive terms reduces the significance of main effects. However, as 2% fat is the base case, it does not interact directly with the WTP for its corresponding milk category like the other two measures of consumption frequency. In Table 4, the bolded interaction rows show the pairing of consumption frequency with the label, both of which largely reflect the negative association shown in the main effects of Model 3.a. Hence, Table 4 shows that frequency of consumption does posit a bit of a moderating effect on WTP and that it is largely associated with the pairing of the frequency of consuming the product for which WTP is assessed. That is, as higher frequency of consuming skim milk decreases the WTP for all milk types through main effects, it has an additional negative effect on WTP for skim milk. Interestingly, frequency of consuming skim milk also showed a negative moderating effect on one's WTP for the 98% fat-free converse of the standard 2% fat label.

Table 4. Main Effects Model with Frequency of Consumption Moderators (Model 3)

Independent variable	Model 3.a			Model 3.b		
98% fat free	-0.148	(0.083)	*	0.510	(0.368)	
Whole	0.094	(0.082)		0.217	(0.359)	
96.75% fat free	-0.075	(0.081)		0.169	(0.335)	
Skim	-0.201	(0.082)	**	0.138	(0.346)	
99.8% fat free	-0.234	(0.083)	***	-0.183	(0.343)	
CF:2% fat	-0.101	(0.020)	***	-0.141	(0.049)	***
CF:Whole	-0.094	(0.020)	***	-0.055	(0.051)	
CF:Skim	-0.178	(0.022)	***	-0.108	(0.052)	**
98% fat free x CF:2% fat				-0.024	(0.069)	
Whole X CF:2% fat				0.106	(0.069)	
96.75% fat free X CF:2% fat				0.034	(0.068)	
Skim X CF:2% fat				0.040	(0.070)	
99.8% fat free X CF:2% fat				0.101	(0.070)	
98% fat free X CF:whole				0.005	(0.072)	
Whole X CF:whole				**-0.187**	**(0.070)**	***
96.75% fat free X CF:whole				-0.060	(0.070)	
Skim X CF:whole				0.025	(0.071)	
99.8% fat free X CF:whole				-0.019	(0.071)	
98% fat free X CF:skim				-0.186	(0.078)	**
Whole X CF:skim				0.030	(0.076)	
96.75% fat free X CF:skim				-0.052	(0.074)	
Skim X CF of CF:skim				**-0.152**	**(0.076)**	**
99.8% fat free X CF:skim				-0.078	(0.074)	
Constant (base: 2% milk)	3.31661	(0.114)	***	3.083	(0.241)	***

Note: Standard errors in parentheses.
Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels.
Base Case: 2% milk

As Table 3 shows, college degrees resulted in higher WTP for milks (relative to 2%). But this characteristic did not moderate differences in WTP for milk types, nor did it indicate that college-educated respondents recognized that the milk labeled as 98% fat free was the same product as 2% fat. Survey participants with higher income also had higher WTP for the average milk in the sample, which makes intuitive sense. Higher income levels are correlated with higher education levels, which indicates a possible indirect moderating effect. Participants on a diet were willing to pay more for milk types (relative to 2%), but this variable had weak statistical significance. Participants who consume milk more frequently showed less WTP for milk types. This finding may indicate that their familiarity with the products enabled them to choose WTPs closer to regular market prices. This also explains why consumption of a certain type of fluid milk helped moderate WTP for that milk for participants.

Relative to Caucasian consumers, African American and Hispanic consumers were willing to pay more for fluid milk. Prior studies suggest that both African Americans and Hispanics consume less

dairy than Caucasians (Bailey et al., 2013; Fulgoni III et al., 2007). This conclusion implies their inflated WTP for liquid milk types may be caused by less familiarity with regular prices of the products. Relative to 2% milk, respondents with higher education were also willing to pay more for other milks. That said, this characteristic does not moderate differences in WTP for milk types, nor did it moderate the effectiveness of these consumers in identifying the 98% fat-free label as equivalent to 2%. This result indicates that academic education may not be necessarily associated with a reduced susceptibility to framing effects. Indeed, survey participants with higher income were willing to pay more in general as higher income levels are correlated with higher education levels. Since we could not identify a moderating effect for advanced education, we can expect that we also would not find one for income levels. Participants on a diet were willing to pay more for milk types (relative to 2%), but this variable had weak statistical significance. Participants who consume milk more frequently showed less willingness to pay for milk types. This result may indicate that their familiarity with the products enabled them to choose WTPs closer to regular market prices. This also explains why consumption of a certain type of fluid milk helped moderate WTP for that milk for participants.

Discussion

This article used a contingent valuation survey experiment to explore the framing effects of fat content on fluid milk labels. Our results indicate that, at least on average, consumers were willing to pay *less* for 2% milk when it is labeled as "98% fat-free milk." Our study indicates that consumers were not willing to pay a different price for 2% and whole milk, but that they would pay less than that for equivalent milk types labeled skim or 99.8% fat free.

Why the decrease in WTP? It is possible that consumers today might perceive "with-fat" milks to be healthier than "non-fat/fat-free" milks. In this case, the presence of "fat-free" framing might nudge consumers away from this option due to its perceived lack of a desirable attribute (higher fat content), in terms of taste or health. Lending credence to this explanation, we found consumer WTP for whole milk to be at least as much as 2% milk but less for skim milk.

Consumer perceptions regarding milk fat have substantially shifted for some time, with likely connections to many overlapping food values. In addition to changes in health perceptions, U.S. consumer dietary habits are also going through generational changes as well as increasing concern regarding environmental sustainability and animal cruelty. In addition, the availability of plant-based substitutes has emerged as a small, but growing, alternative to dairy milk consumption. As such, this study is limited in its scope to capture a comprehensive picture of consumer behavior in the middle of such shifting dynamics. Furthermore, self-reported WTP values may not always reflect real-market payment situations, though this limitation matters insomuch as the bias might vary between each treatment.

As fluid milk sales have declined, milk producers and sellers might benefit from further research on the consequences of framing effects and nudges to dairy consumers. We find that consumers across education and income level are likely to be influenced by labeling changes. In this case, our results suggest that milk marketers are unlikely to experience a benefit from changing the label to

"98% fat free," as consumers would be willing to pay *less* for milk thus labeled. However, this study investigates an area of research—label framing effects in dairy consumption—that is largely unexplored. This study represents only a first step into multiple relevant avenues for future research. Future studies would benefit from a time series approach to understanding how changes in perceptions of fat content have influenced consumer willingness to pay for fluid milk. Furthermore, there is likely to be value in understanding differences in consumer demand for other contexts for different dairy products. There would also be value in considering framed field experimental methods to explore demographic differences regarding how fat content alters the health perceptions of fluid milk for unique consumer populations (Bakke, Shehan, and Hayes, 2016; Ortez et al., 2021). Though our study includes controls for demographic variables, further research may reassess each of these important demographic characteristics more rigorously, focusing on specific sections of the population. There also might be value in exploring the differences between objective knowledge and subjective perception of fluid milk fat in U.S. consumer populations. In addition to studies focused on fat content, framing effects of other important attributes highlighted on milk labels may provide other relevant research questions. Indeed, our study emphasizes the potential of creative thinking for commodity labeling in a rapidly evolving food environment. By exploring characteristics that place an ever-increasing emphasis on nutritional labeling and understanding what information to highlight on labels, promotional ideas might emerge as additional mechanisms relevant for boosting fluid milk sales.

References

Alcantara, M., G. Ares, I.P.L de Castro, and R. Deliza. 2020. "Gain vs. Loss-Framing for Reducing Sugar Consumption: Insights from a Choice Experiment with Six Product Categories." *Food Research International* 136:09458.

Astrup, A., M. Faidon, D.M. Bier, J.T. Brenna, M.C. de Oliveira Otto, J.O. Hill, J.C. King, A. Mente, J.M. Ordovas, and J.S. Volek. 2020. "Saturated Fats and Health: A Reassessment and Proposal for Food-Based Recommendations: JACC State-of-the-Art Review." *Journal of the American College of Cardiology* 76(7):844–857.

Bakke, A.J., C.V. Shehan, and J.E. Hayes. 2016. "Type of Milk Typically Consumed, and Stated Preference, but Not Health Consciousness Affect Revealed Preferences for Fat in Milk." *Food Quality and Preference* 49:92–99.

Becker, M.W., N.M. Bello, R.P. Sundar, C. Peltier, and L. Bix. 2015. "Front of Pack Labels Enhance Attention to Nutrition Information in Novel and Commercial Brands." *Food Policy* 56:76–86.

Boyle, K.J. 2003. "Contingent Valuation in Practice." In P.A. Champ, K.J. Boyle, and T.C. Brown, eds. *A Primer on Nonmarket Valuation*, New York, NY: Springer, pp. 111–169.

Bryant, C.J., and J.C. Barnett. 2019. "What's in a Name? Consumer Perceptions of in Vitro Meat under Different Names." *Appetite* 137:104–113.

Cavanagh, K.V., B. Kruja, and C.A. Forestell. 2014. "The Effect of Brand and Caloric Information on Flavor Perception and Food Consumption in Restrained and Unrestrained Eaters." *Appetite* 82:1–7.

Cho, Y-N., and E. Baskin. 2018. "It's a Match When Green Meets Healthy in Sustainability Labeling." *Journal of Business Research* 86:119–129.

Denburg, N.L., and W.M. Hedgcock. 2015. "Age-Associated Executive Dysfunction, the Prefrontal Cortex, and Complex Decision Making." In *Aging and Decision Making*, edited by T.M. Hess, J. Strough, and C.E. Löckenhoff, 79–101. San Diego: Academic Press.

Garber, L.L., R.R. Burke, and J.M. Jones. 2000. *The Role of Package Color in Consumer Purchase Consideration and Choice*. Cambridge, MA: Marketing Science Institute.

Goodman, S., L. Vanderlee, R. Acton, S. Mahamad, and D. Hammond. 2018. "The Impact of Front-of-Package Label Design on Consumer Understanding of Nutrient Amounts." *NUTRIENTS* 10(11).

Harwood, W.S., and M.A. Drake. 2018. "Identification and Characterization of Fluid Milk Consumer Groups." *Journal of Dairy Science* 101(10):8860–8874.

Jung, M.E., A.E. Latimer-Cheung, J.E. Bourne, and K.A.M. Ginis. 2017. "Targeted Messages Increase Dairy Consumption in Adults: A Randomized Controlled Trial." *Annals of Behavioral Medicine* 51(1): 57–66.

Just, D.R., and G. Gabrielyan. 2016. "Food and Consumer Behavior: Why the Details Matter." *Agricultural Economics* 47(S1):73–83.

Koo, J., and K. Suk. 2020. "Is $0 Better than Free? Consumer Response to '$0' versus 'Free' Framing of a Free Promotion." *Journal of Retailing* 96(3):383–396.

Liebman, M, B.A. Cameron, D.K. Carson, D.M. Brown, and S.S. Meyer. 2001. "Dietary Fat Reduction Behaviors in College Students: Relationship to Dieting Status, Gender and Key Psychosocial Variables." *Appetite* 36(1):51–56.

List, J.A. 2003. "Does Market Experience Eliminate Market Anomalies?" *The Quarterly Journal of Economics* 118(1):41–71.

Malone, T., and J.L. Lusk. 2018a. "A Simple Diagnostic Measure of Inattention Bias in Discrete Choice Models." *European Review of Agricultural Economics* 45(3):455–462.

Malone, T., and J.L. Lusk. 2018b. "Consequences of Participant Inattention with an Application to Carbon Taxes for Meat Products." *Ecological Economics* 145:218–230.

Malone, T., and J.L. Lusk. 2019. "Releasing the Trap: A Method to Reduce Inattention Bias in Survey Data with Application to US Beer Taxes." *Economic Inquiry* 57(1):584–599.

Matjasko, J.L., J.H. Cawley, M.M. Baker-Goering, and D.V. Yokum. 2016. "Applying Behavioral Economics to Public Health Policy: Illustrative Examples and Promising Directions." *American Journal of Preventive Medicine* 50(5): S13–19.

Mozaffarian, D. 2016. "Dietary and Policy Priorities for Cardiovascular Disease, Diabetes, and Obesity: A Comprehensive Review." *Circulation* 133(2):187–225.

Muller, L., A. Lacroix, and B. Ruffieux. 2019. "Environmental Labelling and Consumption Changes: A Food Choice Experiment." *Environmental and Resource Economics* 73(3):871–897.

Newman, C.L., E. Howlett, and S. Burton. 2014. "Shopper Response to Front-of-Package Nutrition Labeling Programs: Potential Consumer and Retail Store Benefits." *Journal of Retailing* 90(1):13–26.

NPD. 2020. *New Year, New Nutrition Facts Label on Food: Most U.S. Consumers Read the Nutrition Facts Label and the Top Items They Look for Are Sugars and Calories*. Port Washington, NY: NPD Group.

O'Connor, A. 2016. "How the Sugar Industry Shifted Blame to Fat." *The New York Post*. Available online: https://www.nytimes.com/2016/09/13/well/eat/how-the-sugar-industry-shifted-blame-to-fat.html.

Ortez, M., B. Courtney, N.O. Widmar, and J. Townsend. 2021. "Dairy Product Purchasing in Households with and without Children." *JDS Communications* 2(1):7–12.

Paterson, M., and S. Clark. 2020. "Use of Auctions to Assess Consumer Value for Milk from Different Packaging." *Jorunal of Dairy Science* 103(5):4121–4137.

Rahn, W.M., S.E. Gollust, and X. Tang. 2017. "Framing Food Policy: The Case of Raw Milk." *Policy Studies Journal* 45(2):359–383.

Roberto, C.A., and I. Kawachi. 2014. "Use of Psychology and Behavioral Economics to Promote Healthy Eating." *American Journal of Preventive Medicine* 47(6):832–837.

Roseman, M.G., H. Joung, and E.I. Littlejohn. 2018. "Attitude and Behavior Factors Associated with Front-of-Package Label Use with Label Users Making Accurate Product Nutrition Assessments." *Journal of the Academy of Nutrition and Dietetics* 118(5):904–912.

Rothman, R.L., R. Housam, H. Weiss, D. Davis, R. Gregory, T. Gebretsadik, A. Shintani, and T.A. Elasy. 2006. "Patient Understanding of Food Labels: The Role of Literacy and Numeracy." *American Journal of Preventive Medicine* 31(5):391–398.

Siri-Tarino, P.W., Q. Sun, F.B. Hu, and R.M. Krauss. 2010. "Meta-Analysis of Prospective Cohort Studies Evaluating the Association of Saturated Fat with Cardiovascular Disease." *The American Journal of Clinical Nutrition* 91(3):535–546.

Smith, S.M., C.A. Roster, L.L. Golden, and G.S. Albaum. 2016. "A Multi-Group Analysis of Online Survey Respondent Data Quality: Comparing a Regular USA Consumer Panel to MTurk Samples." *Journal of Business Research* 69(8):3139–3148.

Stewart, H., D. Dong, and A. Carlson. 2013. *Why Are Americans Consuming Less Fluid Milk? A Look at Generational Differences in Intake Frequency*. Washington, DC: U.S. Department of Agriculture, Economic Research Service.

Thaler, R., and C. Sunstein. 2008. *Nudge: Improving Decisions about Health, Wealth, and Happiness*. London, United Kingdom: Penguin.

U.S. Census Bureau. 2020. *American Community Survey.* Washington, DC: U.S. Census Bureau.

U.S. Department of Agriculture. 2020. *Fluid Beverage Milk Sales Quantities by Product (Annual).* Washington, DC: U.S. Department of Agriculture, Economic Research Service.

Vecchio, R., and C. Cavallo. 2019. "Increasing Healthy Food Choices through Nudges: A Systematic Review." *Food Quality and Preference* 78:103714.

Vitaliano, P. 2016. "Global Dairy Trade: Where Are We, How Did We Get Here and Where Are We Going?" *International Food and Agribusiness Management Review* 19(1030-2016–83115):27–36.

Walsh, B. 2014. "Ending the War on Fat." *TIME*.

Whoriskey, P. 2015. "For Decades, the Government Steered Millions Away from Whole Milk. Was That Wrong?" *The Washington Post*. Available online: https://www.washingtonpost.com/news/wonk/wp/2015/10/06/for-decades-the-government-steered-millions-away-from-whole-milk-was-that-wrong/.

Wolf, C.A., T. Malone, and B.R. McFadden. 2020. "Beverage Milk Consumption Patterns in the United States: Who Is Substituting from Dairy to Plant-Based Beverages?" *Journal of Dairy Science* 103(12):11209–11217.

Zanoli, R., S. Naspetti, M. Janssen, and U. Hamm. 2015. "Mediation and Moderation in Food-Choice Models: A Study on the Effects of Consumer Trust in Logo on Choice." *NJAS - Wageningen Journal of Life Sciences* 72–73:41–48.

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Consumer Preferences for "Made with Tennessee Milk" Processed Dairy Products

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Abstract

This study examines consumer willingness to pay (WTP) for a hypothetical logo on processed dairy products (cheese, butter, sour cream, ice cream, or yogurt), indicating the products are made in Tennessee using Tennessee milk. A survey of 381 Tennessee consumers elicited WTP for logoed processed dairy products using the contingent valuation method. Results show consumers' WTP to be $2.61 more weekly for processed products bearing the *Made with Tennessee Milk* logo. Of those interested in buying the logoed processed dairy products, 13% would likely shop for the products at farmers' markets or farm stands.

Keywords: dairy products, local, willingness to pay, shopping patterns

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Introduction and Objectives

The Tennessee Department of Agriculture (TDA), enabled by legislation, established a *TN Milk* logo program in September 2018 (TDA, 2018). This logo can only appear on fluid milk that is produced, processed, and bottled within the state (see Figure 1). Previous research by DeLong et al. (2020) found that consumers would pay a premium for fluid milk bearing this logo. However, it is unclear if this premium would extend to a state logo indicating that processed dairy products such as ice cream, butter, cheese, or yogurt were produced with Tennessee fluid milk. Since a logo for processed dairy products made with Tennessee milk does not yet exist, this paper investigates consumers' willingness to pay for a hypothetical logo, *Made with TN Milk.* This may be particularly important for policy makers and producers to understand given the decline in the United States per capita consumption of fluid milk over the past decade and the large portion of fluid milk, approximately two-thirds in 2019, that is used to produce processed dairy products (Agricultural Marketing Resource Center, 2021; USDA/ERS, 2021; USDA). Consumers' willingness to pay a premium for locally processed dairy products produced with local milk may suggest policy makers could develop appropriate logo programs to help producers capture these premiums.

Figure 1. *TN Milk* Logo

Given the weekly amount of around $E1 you indicated that you spend on processed dairy products, would you be willing to pay P% more for these dairy products if they have the Made with Tennessee Milk Logo? This would make your weekly expenditures about $E2.

○ Yes

○ No

Figure 2. *Made with TN Milk* Processed Dairy Products Choice Question

Hence, the goal of this research is to ascertain consumers' preferences and willingness to pay for processed dairy products bearing the hypothetical logo *Made with TN Milk*. This study also seeks to identify target market segments for processed dairy products bearing the *Made with TN Milk* logo. Because farmers' markets and/or farm stores/stands may serve as initial sale entry points for locally made dairy products, the influence of consumer shopping preferences for dairy products at these types of outlets is investigated.

To obtain data for the study, a survey of adult Tennessee consumers who are primary food shoppers and whose household has one or more members that at least occasionally consume milk and/or dairy products was conducted in 2019. To estimate consumer WTP a premium over conventional dairy products, this study uses the contingent valuation method to elicit Tennessee consumer preferences for processed dairy products carrying the hypothetical *Made with TN Milk* logo. The study also includes a logit model examining the probability that those who would purchase *Made with TN Milk* dairy products would shop for them at farmers' markets or farm stores. Results from the study are informative in understanding (i) whether consumers would pay premiums for processed dairy products that are made with local milk and (ii) drivers of consumer shopping preferences for these products.

Literature Review

Consumer Preferences for Local Dairy and Other Food Products

Darby et al. (2008) investigated the value of localness generally and found that consumers valued localness separately from other attributes, such as freshness and the size of the farm that produced the product. Their results also showed that a local label was viewed similarly to a state-based label. Hence, state lines may form a boundary for localness in the minds of consumers. Barnes et al. (2014) found that WTP for lesser-known cheeses was heavily influenced by brand and that although the local brand received the highest sensory ratings, it received the lowest WTP. The low WTP for a lesser-known brand was only offset when a state-based identification was added. They also found that local designations strengthened brands in general, but state designations appeared to be most effective for lesser-known, high-quality cheeses. In the current study, we examine the effect of a state-based logo for a local ingredient (milk) used to produce a dairy product locally. DeLong et al. (2020) examined Tennessee consumer preferences and found they would pay about a 12% premium for fluid milk labeled as *TN Milk*, which is defined as fluid milk that is entirely sourced, processed, and bottled in Tennessee. However, it is important to note that this premium percentage could be different for milk versus processed dairy products. Olynyk and Ortega (2013) studied consumers' WTP premiums for attributes in ice cream and yogurt, including cattles' pasture access, use of antibiotics, and rbST. They found that WTP premiums as a percentage of product price for the studied attributes within yogurt were higher than for ice cream, and they posited this might be the case because consumers may associate yogurt as being in a less processed form than ice cream. Hence, based on their findings, it is possible that the *Made with TN Milk* logo might have a lower percentage premium than *TN Milk.*

Neither DeLong et al. (2020) nor Best and Wolfe (2009) found strong effects of demographics on preferences for locally produced milk in the region. However, some prior studies have found WTP for locally processed products and fresh produce to be at least partially driven by demographics. Education has been shown to have a negative effect on WTP for locally made dairy products (Forbes-Brown, Micheels, and Hobbs, 2015) and specialty foods (Giraud, Bond, and Bond, 2005). Forbes-Brown, Micheels, and Hobbs (2015) found that older consumers were more likely to be WTP a premium for dairy products made with Canadian milk. Barnes et al. (2014) found that older, middle-income females were more likely to pay for state-sponsored designation in cheeses. Darby et al. (2008) examined the effects of demographics on preferences for local attributes in fresh strawberries and only found gender to be significant. They found that male direct-market shoppers in their sample exhibited stronger preferences for locally grown products than females. A locally based label or logo may hold perceived quality benefits, such as greater freshness, better taste, more safety, or environmental benefits. In addition, locally based labels may hold perceived economic benefits, such as greater local farm incomes or helping support the local economy.

Results from DeLong et al. (2020) showed perceived quality benefits (freshness, taste, safety, and environmental) associated with a local milk logo had positive effects on WTP for the locally labeled milk, but perceived economic benefits (benefits to farmers and local economies) had no significant effect. Similar to findings by Delong et al. (2020), Gedikoglu and Parcell (2014) found that consumers responded positively to possible product benefits, such as taste, but supporting local farmers had no effect on whether consumers would pay a premium for artisanal cheese. Zepeda and Li (2006) did not find that attitudes or behaviors related to the environment or health to be significant influences on whether shoppers buy local foods. However, Njange et al. (2011) also found that consumers' WTP for an *Arizona Grown* label varied across two products, spinach and carrots. They also posited that WTP was greater for the spinach than carrots as a result of a recent food safety incident with spinach. Hence, they hypothesized that WTP for local produce might be driven in part due to food safety concerns. Based on findings from these studies, we anticipate that local quality benefits would positively influence WTP for processed dairy products with the *Made with TN Milk* label. However, based on findings from these studies, economic benefits (benefits to farmers and local economies) may not significantly influence WTP for processed dairy products that are *Made with TN Milk*.

Studies have shown that preferences for local foods influence WTP for state-logoed foods. DeLong et al. (2020) found that consumers who stated they paid premiums for local food products were more likely to choose *TN Milk*. Studies of other nondairy products have also found that state logos and preferences for local foods can influence WTP for foods. Giraud, Bond, and Bond (2005) discovered that pro-local attitudes positively influenced WTP for specialty foods products that were labeled as locally made. Zepeda and Li (2006) found that attitudes and behaviors related to food and shopping significantly increased shoppers' buying local foods. Based on these studies' findings, we would anticipate that preferences for local foods, as measured by WTP a premium for local foods, will have a positive effect on WTP a premium for processed dairy products bearing the *Made with TN Milk* logo.

Several studies have examined WTP for dairy products and/or local products. However, this study examines the effects of a state-based logo on WTP for dairy products that are made locally with locally produced milk and provides a unique contribution to the literature. DeLong et al. (2020) examined the effects of a state-based logo on WTP for milk, but did not examine the effects of a state-based logo on WTP for other dairy products. Although Best and Wolfe (2009) examined consumers' willingness to purchase and pay more for dairy products, their analysis did not include estimates of WTP. While Geidikoglu and Parcell's (2014) findings provide insights into drivers of preferences for artisanal cheese preferences, their study did not specifically examine the consumer perceptions of cheese that was labeled as locally made using local milk. Also, Barnes et al. (2014) examined the effects of a state-sponsored designation on consumer willingness to pay for cheeses; however, their results were limited to cheeses and not the broader products grouping. Further, this study not only examines the WTP for the logoed dairy products, but also the factors that drive consumer shopping for these products at farmers' markets and farm stores, which might serve as initial market entry points for smaller processors.

Shopper Preferences for Farmers' Markets

Because locally produced processed dairy products might initially be offered at farm stores or farmers' markets, it is also helpful to examine findings from prior research regarding use of these shopping outlets. Gumirizaka, Curtis, and Bosworth (2014) found that consumers who attended farmers' markets were primarily interested in purchasing fresh produce, followed by reasons related to social interaction. Ready-to-eat foods or packaged foods were lesser motivators. Those who intended to purchase fresh produce at farmers' markets tended to be married, females, of higher income levels, with diet or health concerns, and supportive of local farming. Conner et al. (2010) found that supporting local farmers was a motivator for attending farmers' markets. Zepeda and Carroll (2018) found that shoppers at farmers' markets tended to be white and more likely to shop at farmers' markets regularly. Zepeda (2009) found no significant difference in overall food expenditures or household income between farmers' market shoppers and non-shoppers. With respect to demographics, Zepeda (2009) found farmers' market shoppers were more likely to be female, but found no significant differences in education or race across the two types of shoppers.

Other studies have found a positive association between farmers' market visits and higher education levels (Govindasamy et al., 1998; McGarry Wolf, Spittler, and Ahern, 2005; Onianwa, Mojica, and Wheelock, 2006; Abello et al., 2014). Abello et al. also found a negative correlation between distance to market and visits. Based on the findings from these prior studies, it is possible that shoppers looking for processed dairy products with the *Made with TN Milk* logo are more likely to shop for these products at farmers' markets or farm stores. Those who indicate they would shop for them at these outlets might more likely be female, highly educated, supportive of local farmers (economic benefits), and frequent farmers' market food shoppers.

Methods

Survey Data Collection and Referendum-Style Contingent Valuation

Survey data were collected via the online platform Qualtrics in June 2019. Qualtrics provided a panel of Tennessee residents who were aged 18 years or older and who were primary food shoppers for their household. Also, to qualify for the survey, the respondent or someone residing in their household was required to consume milk or dairy products at least occasionally. Qualtrics recruited panelists until at least 400 qualified responses were obtained. All survey materials and protocols were approved by the University of Tennessee Institutional Review Board (UTK IRB-18-04484-XM).

Demographic summary measures for the survey respondents were calculated and are shown in Table 1. They were compared with state averages to examine the representativeness of the sample. The comparisons are discussed in the results section of this paper.

Table 1. Survey Respondent Demographics and State Averages

Demographic	Sample Average	State Average or Median[a]
Age in years	43.69	39
Female gender	82.4	51
Annual household income	$46,024	$52,000[b]
College graduate	23.1%	27.5%
Household size	3.00	2.52

[a]Source: U.S. Census Bureau, 2020
[b]Median of household income

The survey began with questions about household consumption of milk and dairy products. The current *TN Milk* logo was presented to respondents, and they were asked to rate their familiarity with the existing logo prior to the study. The survey questions related to processed dairy products and whether one or more of the household members consumed processed dairy products (e.g., cheese, ice cream, sour cream, yogurt, or butter). A question regarding weekly expenditures on dairy products was asked in categorical form ($1–$3, $3–$5, $5–$10, $10–$15, $15–$20, and $20 or more). Midpoints were used to calculate weekly expenditures, with the $20 endpoint being used as the maximum to create the variable *Wkly Expend*.

The respondents were then shown an information screen about a hypothetical *Made with TN Milk* logo (logo shown in Figure 2). In this information screen, the following logo information was provided:

"The Made with *TN Milk* logo [that] appears on processed dairy products would indicate that these products use milk that is entirely sourced and processed in Tennessee. This means the milk used in making the processed dairy products (for example, cheese, yogurt, sour cream, or ice cream) with this logo is 100 percent from Tennessee dairy farms."

After providing survey participants with the definition of and hypothetical logo for *Made with TN Milk*, they were informed that they would be making a hypothetical product choice. The respondents were reminded that they should try to make as realistic a choice as possible (Blamey, Bennett, and Morrison, 1999). They were also reminded to consider their household budget, and if they spent more on processed dairy products, they would have less to spend on other goods (Cummings and Taylor, 1999).

An example of a choice set is provided in Figure 2. A referendum-style contingent valuation method was used to elicit consumers' willingness to pay more for their dairy products each week if the products were labeled as *Made with TN Milk*. With a referendum style, the consumer could choose to select the logoed dairy products at the premium percent offered or not choose these products. This method of elicitation was used for three reasons. First, the primary interest was eliciting the willingness to pay for the *Made with TN Milk* logo on processed dairy products, a single attribute. Second, we investigated the WTP premium of the logo for a grouping of dairy products, hence the simplicity of a referendum-style question was appealing. Furthermore, this style of question enabled us to prompt respondents with a reminder about the level of their self-reported usual weekly expenditures on processed dairy products (E1) and then, based on the percentage premium they selected, provide them with the amount in additional spending this would entail.

In the choice question, respondents were asked if they would pay a certain percentage premium, *Pct Premium* (5%, 8%, 10%, 15%, or 20%), more for the processed dairy products (ice cream, butter, sour cream, yogurt) if they were *Made with TN Milk* and carried the logo. Twenty percent of the sample saw each percentage premium level. The respondents were also prompted with the dollar amount of their usual weekly dairy products expenditures (E1), and this amount plus the premium E2 where E2 = E1*(1+P) and P is the premium in decimal form. For example, if they indicated they usually spent around $4 a week on processed dairy products, and they would pay 10% more for the logoed dairy products, the question was, "Given the weekly amount of around $4 you indicated that you spend on processed dairy products, would you be willing to pay 10% more for these dairy products if they had the *Made with TN Milk* logo? This would make your weekly expenditures about $4.40." The respondent could then answer yes or no.

Following the product choice question, respondents interested in purchasing the logoed dairy products were asked about where they might buy the logoed processed dairy products, including retail stores, farmers' markets, on-farm stores, food cooperatives, home delivery, wholesale clubs, specialty stores, limited assortment stores, convenience stores, big box stores, and other. The focus of this study was farmers' markets and on-farm stores ($y_{FMKTSTORE}$) because they may likely be an initial market channel where these logoed dairy products would be sold. Survey participants were asked how far out of their way they would travel to buy processed dairy products that are labeled with the *Made with TN Milk* logo. Choices included 1–2 miles, 2–3 miles, 3–4 miles, or 5 miles or greater. Around half of the respondents indicated they would travel greater than 3 miles. A dummy variable, *Travel Miles GT3,* captures respondents who are willing to travel greater than 3 miles and was used in the model of the probability of shopping for logoed dairy products at farmers' markets or farm stores.

Agreement ratings (1 = strongly disagree, …, 5 = strongly agree) for statements regarding the dairy products with the logo relative to non-logoed products were considered but found to be very correlated with one another. The correlations were that the products *Made with TN Milk* would be (i) fresher, (ii) safer, (iii) better for the environment, (iv) help support farm incomes, (v) help the local economy, and (vi) taste better. Cronbach's alpha (Cronbach, 1951) was used to test for reliability of using a linear index to represent the variables. The variables *fresher*, *safer*, *better for the environment*, and *taste better* (alpha = 0.90) were formed into a simple average index called *Quality Benefits*. The variables *help support farm incomes* and *help the local economy* (alpha = 0.87) were formed into a simple average index called *Economic Benefits*.

Survey participants were asked about their agreement with statements on a scale of 1 = strongly disagree, ..., 5 = strongly agree regarding local foods (purchase local foods regularly, shop at a local farmers' market regularly, would pay price premiums for locally produced food). Dummy variables were generated from these with the values of "1" if the respondent agreed or strongly agreed with the statement or "0" otherwise (*Shop Local Foods, Shop Farmers' Markets Regularly,* and *Premium Local).*

Next, questions were asked about where the survey participants obtained information about milk and other dairy products. These sources included family and friends (*Info Family/Friends*), the Internet and social media (*Info Internet/Social Media*), and store representatives (*Info Store*). Survey participants were then asked demographic questions, such as age (*Age, AgeSq*), gender (*Female*), education (*College Graduate*), household income (*Income*), urbanization of residence (*Metro*), race (*White Race*), and household size (*Household Size*).

Economic Model and Conceptual Framework for Willingness to Pay

Following random utility theory, a consumer will choose a product if the utility they derive from that product is greater than if they do not choose it (McFadden, 1974). The individual, *i*, will choose the dairy products labeled as *Made with TN Milk* if their expected utility from choosing the products denoted by $E(U_{i,Made\ TN_{Milk}})$ is greater than their expected utility if they do not choose them, represented by $E(U_{i,0})$. While the difference in the two expected utility levels ($y^*_{i,Made\ TN_{Milk}}$) cannot be observed directly, an indicator ($y_{i,Made\ TN_{Milk}}$) can be. In this case, the consumer chooses the dairy products *Made with TN Milk,* or they do not. This difference in expected utility ($y^*_{Made\ TN_{Milk}}$) can be expressed as a function of the variables, such as prices, demographics, expenditure patterns, or opinions ($\boldsymbol{x}$), a set of parameters associated with the variables ($\boldsymbol{\beta}$), and a random error term (ε) where

$$y^*_{Made\ TN_{Milk}} = \boldsymbol{x}'\boldsymbol{\beta} + \varepsilon. \tag{1}$$

The observed indicator reflects whether the dairy products *Made with TN Milk* are chosen such that

$$y_{Made\ TN_{Milk}} = \begin{cases} 1 & \text{if} \quad y^*_{Made\ TN_{Milk}} > 0 \\ 0 & \text{otherwise} \end{cases}. \tag{2}$$

The probability that a consumer will choose the processed dairy products that are *Made with TN Milk* ($\Pr[y_{Made\,TN_{Milk}} = 1]$) is then,

$$\Pr[y_{Made\,TN_{Milk}} = 1] = \Pr[\boldsymbol{x'\beta} + \varepsilon > 0 | \boldsymbol{x'\beta}] = \mathrm{F}(\boldsymbol{x'\beta}) \quad (3)$$

where F is the cumulative logistic distribution function (Greene, 2018). In the case of this study, the independent variables, $\boldsymbol{x}$, the percent premium for processed dairy products that bear the *Made with TN Milk* logo compared with dairy products not bearing this logo, consumer weekly dairy product expenditures, perceived quality and economic benefits of the products, attitudes toward localness, *TN Milk* logo familiarity, farm background, demographics, and use of information sources about milk and dairy products. The variable names, definitions, and summary measures for those comprising $\boldsymbol{x}$ are shown in Table 2. The dependent variable $y_{Made\,TN_{Milk}}$ model is equal to 1 if a consumer selected the dairy products *Made with TN Milk* at the specified premium, and 0 otherwise. Note the means presented in Table 2 for useable responses where the respondent qualified to be in the study and answered all questions used in the estimation of the logit model of WTP.

To estimate the logit regression and the associated marginal effects, the *logit* and *margins* commands in STATA 17.0 were used (StataCorp, 2017). The marginal effect of the k^{th} variable on $\Pr[y_{Made\,TN_{Milk}} = 1]$ is $f(\boldsymbol{x'\beta})^* \boldsymbol{\widehat{\beta}_k}$, where $f(\boldsymbol{x'\beta})$ is the logistic density function calculated at $\boldsymbol{x'\beta}$. For a squared explanatory variable, such as *AgeSquared*, the marginal effect is calculated as $f(\boldsymbol{x'\beta})$*(b_{Age}+2*$b_{Age\,Squared}$**Age*), where $f(\boldsymbol{x'\beta})$ is the logistic density function.

In addition, the variance inflation factors (VIFs) (scores greater than 10) and conditional index tests (scores greater than 30) were used to evaluate the presence of multicollinearity among the independent variables using the *vif* and *coldiag2* Stata commands (StataCorp, 2017). A VIF of under 10 indicates that multicollinearity is not a concern with the independent variables (Gujarati and Porter, 2009). A conditional index number of under 30 indicates multicollinearity is not a concern (Belsley, 1991).

Shopping for Products at Farmers' Markets and Farm Stores

Those survey participants who indicated they would purchase the *Made with TN Milk* processed dairy products were asked about whether they would anticipate shopping for these products at farmers' markets or farm stores ($y_{FMKTSTORE}$=1). Anticipated shopping at these types of outlets was examined because they may be some of the initial avenues for smaller farmer/processors to enter the market (Onyango Govindasamy, and Alsup-Egbers, 2015).

Table 2. Definitions and Summary Statistics of Tennessee Survey Respondents for Variables Used in the Estimation of the Logit Regression of Probability of Choosing Dairy Products that are *Made with TN Milk* ($\Pr[y_{Made\ TN_{Milk}} = 1]$) and Logit Regression of Probability of Shopping at Farmers' Markets/Farm Stores for Dairy Products that are *Made with TN Milk* ($\Pr[y_{FMKTSTORE}=1]$)[a]

		Probability of Choosing Dairy Products that are *Made with TN Milk* Respondents			**Probability of Shopping at Farmers' Markets/Farm Stores for Dairy Products that are *Made with TN Milk* Respondents**		
Variable	**Definition**	**Mean**	**Min (N = 381)**	**Max**	**Mean**	**Min (N = 247)**	**Max**
	1 if chose dairy products *Made with TN Milk*, 0 otherwise	0.648	0	1	----	----	----
	1 if would shop for dairy products *Made with TN Milk* at farmers markets' or farm stores	----	----	----	0.134	0	1
Pct premium	Percent price premium for dairy products *Made with TN Milk* (5%, 8%, 10%, 15%, 20%)	11.28%	5	20			
Wkly expend	Weekly expenditures on dairy products	$11.14	2	20	10.988	2	20
Economic benefits	Economic benefits index (help local dairy farmers, help local economy), 1 = strongly disagree, …,5 = strongly agree	4.367	1	5	4.47	1	5
Quality benefits	Quality benefits index (fresher, safer, better for environment, taste better), 1 = strongly disagree, …,5 = strongly agree	3.638	1	5	3.892	1	5
Premium local	Will pay premium for local foods, 1 if agree or strongly agree, 0 otherwise	0.312	0	1	----	----	----
TN milk logo familiarity	1 = if at least moderately familiar, 0 otherwise	0.152	0	1	0.1984	0	1
Farm background	1 if self-identify as having a farm background, 0 otherwise	0.444	0	1	0.474	0	1
Female	1 if female gender, 0 otherwise	0.824	0	1	0.813	0	1

Table 2. (cont)

		Probability of Choosing Dairy Products that are *Made with TN Milk* Respondents			**Probability of Shopping at Farmers' Markets/Farm Stores for Dairy Products that are *Made with TN Milk* Respondents**		
Variable	**Definition**	**Mean**	**Min (N = 381)**	**Max**	**Mean**	**Min (N=247)**	**Max**
Age	Age in years	43.69	18	79	44.259	18	79
AgeSq	Age in years squared	2,104.05	324	6,241	2165.470	324	6241
Income	Household income in thousand dollars (2018)	46.024	5.000	150.000	47.975	5.000	150.000
College graduate	1 if college graduate, 0 otherwise	0.231	0	1	0.251	0	1
Household size	Number of persons residing in the household	2.997	1	8	2.951	1	8
White race	1 if self-identify as primarily white race, 0 otherwise	0.864	0	1	0.854	0	1
Metro	1 if reside in metro area, 0 otherwise	0.167	0	1	0.162	0	1
Info family/friends	1 if obtain information about milk and dairy products from family and friends, 0 otherwise	0.333	0	1	0.364	0	1
Info internet/social media	1 if obtain information about milk and dairy products from the Internet or social media, 0 otherwise	0.136	0	1	0.162	0	1
Info store Representatives	1 if obtain information about milk and dairy products from store representatives, 0 otherwise	0.052	0	1	0.061	0	1
Shop farmers' markets regularly	Shop farmers' markets for food regularly, 1=if agree or strongly agree, 0 otherwise	----	----	----	0.34	0	1
Shop local foods	Shop for local foods regularly, 1 if agree or strongly agree, 0 otherwise	----	----	----	0.567	0	1
Travel miles GT3	1 if would travel greater than 3 miles to shop for *Made with TN Milk* dairy products, 0 otherwise	----	----	----	0.506	0	1

The decision to shop for the processed dairy products at these types of outlets is also assumed to follow random utility theory, ultimately resulting in estimation of the probability of shopping for the products at farmers' markets/farm stores or other specialty stores. This probability that survey participants anticipate shopping at a farmers' market, farm store, or other specialty store ($y_{FMKTSTORE}$=1) can be expressed as,

$$\Pr[y_{FMKTSTORE} = 1] = \Pr[\boldsymbol{z}'\boldsymbol{\gamma} + \xi > 0|\boldsymbol{z}] = \mathrm{F}(\boldsymbol{z}'\boldsymbol{\gamma}), \quad (5)$$

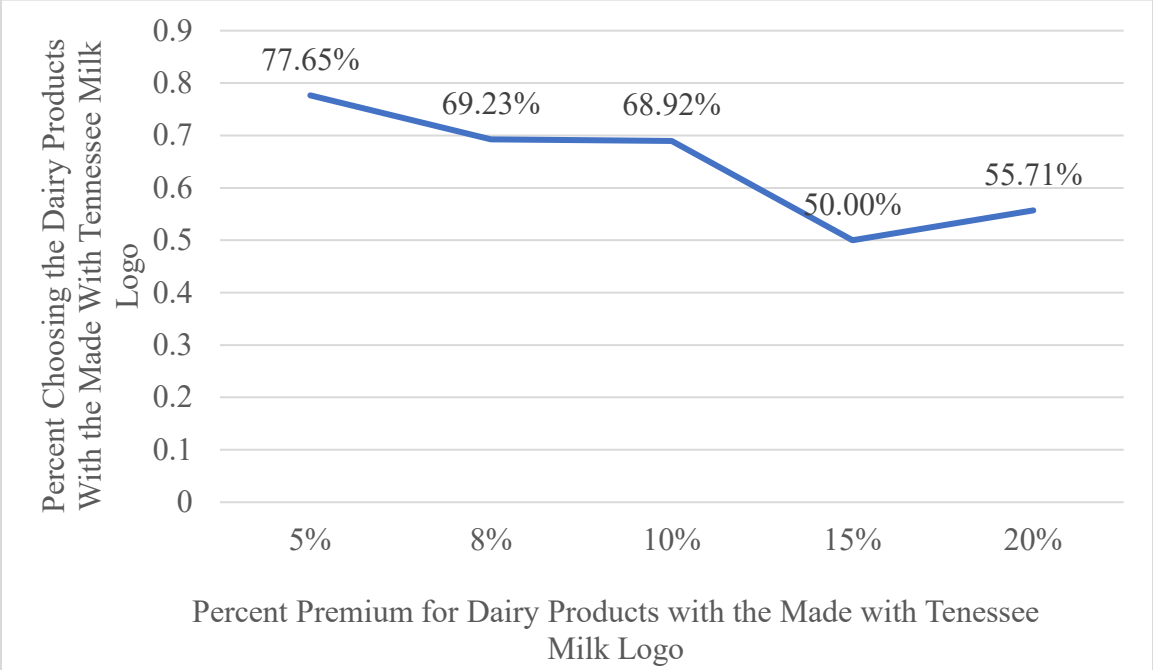
where F is the cumulative logistic distribution function, $\boldsymbol{z}$ is comprised of consumer demographics and other variables, $\boldsymbol{\gamma}$ are the associated parameters to be estimated, and ξ is the random error component (Greene, 2018). The independent variables, **z**, consist of consumer demographics, local foods perceptions, weekly dairy products expenditures, attitudes toward quality and economic benefits associated with products bearing the *Made with TN Milk* logo, and sources of dairy products information. The independent variables also include shopping patterns for local foods, farmers' markets, and distance one would travel out of their way to purchase *Made with TN Milk* dairy products. The variable names, descriptions, and summary measures for this logit model are presented in columns 6 through 8 in Table 2. The *logit* module is used to estimate the probability in STATA 17.0 (StataCorp, 2021) along with the estimated marginal effects of the variables on probability of shopping for the logoed processed dairy products at these types of outlets. As with the model of WTP, multicollinearity testing is conducted using the methods described in that section.

Results

A total of 409 individuals qualified for the survey (Tennessee residents who were aged 18 years or older, who were a primary household food shopper, and whose household consumed milk or dairy products). Individuals who qualified for the survey but did not answer all questions needed to estimate the logit model for the WTP for the processed dairy products with the *Made with TN Milk* logo were omitted from the analysis, resulting in a total of 381 useable responses.

To examine how representative the sample is of Tennessee consumers, several summary measures of the demographics of survey respondents are shown in Table 1 and compared with state averages or medians based on U.S. census data (U.S. Census Bureau, 2020). Compared with the general Tennessee population, respondents tended to be older (sample average of 44 years versus the state average of 39 years), were more likely to be female (sample average of 82.4% versus the state average of 51%), have a lower income (sample median of $46,024 versus the state median of $52,000), and were less likely to be a college graduate (sample, 23%, versus state, 27.5%). Household size was fairly similar (sample average of 3 persons versus the state average of 2.52). Discrepancies from the state averages may reflect the nature of the survey, which utilized primary food shoppers and included only households that regularly purchase milk and dairy products. In particular, prior research has found that the majority of household food shoppers are female (Schaeffer, 2019).

Overall, 65% of consumers would choose dairy products *Made with TN Milk* (see Table 2). As with DeLong et al. (2020), this result suggests that consumers are interested in choosing a product produced in Tennessee. Figure 3 further examines the percentages of consumers who would choose *Made with TN Milk* at the various premium levels provided. For example, among consumers presented with the 5% premium for *Made with TN Milk*, 78% chose to purchase; among consumers presented with the 8% premium, 69% chose to purchase. Figure 3 shows an unexpected, but small, increase in the percent of consumers choosing to purchase the *Made with TN Milk* dairy products (50% to 56%) when moving from the 15% to 20% premium levels, which may be due in part to the small number of consumers exposed to each price premium. Given that 20% of respondents were assigned to each price premium, only a few additional affirmative responses would be required for the percentage of consumers choosing the *Made with TN Milk* products at the given price premium to increase from 50% to 55%. Thus, this increase may not be significantly different.



N = 381

Figure 3. Percent of Tennessee Survey Respondents Choosing the *Made with TN Milk* Dairy Products at the Percent Premiums Provided

Consumers' average weekly dairy product expenditure was $11.14. When asked if the economic benefits of *Made with TN Milk* would include helping farmers and local communities, the average response was 4.4, suggesting that respondents on average "agree" with this statement. When asked about the quality benefit of *Made with TN Milk* (i.e., products would be fresher, safer, better for the environment, or taste better), the average response was 3.6, suggesting that respondents "slightly agreed" with this statement. Thirty-one percent of consumers stated they would pay a premium for local foods; however, only 15% of consumers were at least moderately familiar with

the *TN Milk* logo. Therefore, more advertising would likely be beneficial for this TDA logo campaign. Nearly 44% of consumers considered themselves to have a farming background.

Willingness to Pay Estimates

The estimated logistic regression of the probability of selecting the *Made with TN Milk* dairy products is shown in Table 3. As can be seen from the log-likelihood ratio test against an intercept only model, the model is significant overall. In addition, the model correctly classified 77.17% of the observations, while the pseudo R^2 was 0.2567. The VIF was 5.68. However, the Condition Number was higher than desired at 87.58. *AgeSquared* was thought to be a likely contributor to the high condition number. As a test, *AgeSquared* was removed, and the Condition Number fell to around 30. Hence, the high Condition Number is attributable to the squared term for age and not the other regressors. For the purposes of measuring nonlinear effects of age, both the variable and its squared term were left in the model.

The estimated coefficient on the percent premium for the dairy products bearing the logo (*Pct Premium*) was negative and significant as expected. As indicated by the marginal effect, for each percent increase in price premium, the probability of selecting the logo-bearing processed dairy products would decrease by around 1.3%. The WTP estimate was a 23.42% premium compared with usual weekly expenditures on dairy products and was higher than that found for *TN Milk* in DeLong et al. (2020). Because households spent an average of $11.14 on dairy products weekly, the premiums suggest households would spend an additional $2.61 ($11.14 times 23.42%) on dairy products labeled as *Made with TN Milk*, or $13.75 for *Made with TN Milk* dairy products weekly.

Table 3. Estimated Logit Regression of Probability of Choosing Dairy Products That Are *Made with TN Milk* (Pr[$y_{Made\ TN_{Milk}} = 1$]) among Tennessee Survey Respondents[a]

					Effect on WTP [b]		
Variable	**Est Coeff**		**Marginal Effect on Pr[$y_{Made\ TN_{Milk}}$=1]**		**Mean**	**95% LCL**	**95% UCL**
Intercept	-0.922						
Pct premium	-0.078	***	-0.013	***			
Wkly expend	-0.067	**	-0.011	**	-0.856	-1.719	0.007
Economic benefits	-0.082		-0.013		-1.043	-5.098	3.013
Quality benefits	1.061	***	0.170	***	**13.517**	**4.336**	**22.699**
Premium local	1.695	***	0.272	***	**21.596**	**5.971**	**37.221**
TN Milk logo familiarity	0.900	*	0.144	*	11.462	-3.056	25.980
Farm background	0.209		0.034		2.668	-4.622	9.958
Female	0.409		0.066		5.205	-4.739	15.149
Age	-0.117	*	-0.019	*	-1.485	-3.184	0.215
AgeSq	0.002	**	0.000	**	0.020	0.000	0.040
Income	0.000		0.000		0.000	0.000	0.000

Table 3. (cont)

Variable	Est Coeff		Marginal Effect on Pr[$y_{Made\ TN_{Milk}}$=1]		Effect on WTP [b] Mean	95% LCL	95% UCL
White race	-0.064		-0.010		-0.809	-10.905	9.287
Metro	0.043		0.007		0.554	-8.735	9.843
Info family friends	0.325		0.052		4.140	-3.864	12.144
Info internet social media	0.722	*	0.116	*	9.194	-2.352	20.741
Info store reps	0.893		0.143		11.373	-4.247	26.992
Pct premium WTP					23.42	18.04	43.65
N = 381							
LLR against intercept only Model = 126.86***							
Pseudo R^2 = 0.2567							
Percent correctly classified = 77.17%							
VIF = 5.68							
Condition Number = 87.58							

[a]Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels.
[b]Bolded values in the effect on WTP are those for which the mean, lower 95% confidence level and upper 95% confidence level are all positive or all negative, indicating a significant difference from zero at the 95% confidence level.

Households with higher weekly expenditures on dairy products (*Wkly Expend*) were less likely to pay a premium for *Made with TN Milk* dairy products, possibly because households with higher weekly dairy product expenditures would have to pay the most total expenditure increase if their dairy products increased by a percentage premium. An increase in expenditures by $1 per week decreases the probability of purchasing *Made with TN Milk* dairy products by 1.1%. However, the marginal effects of weekly expenditures on the WTP for the *Made with TN Milk* dairy products are not significant at the 95% confidence level. This latter result suggests that, on average, regardless of weekly dairy products expenditures, consumers would be willing to pay about the same percentage premium for processed dairy products bearing the *Made with TN Milk* logo.

While the *Quality Benefits Index* had a positive and significant effect on the probability of choosing *Made with TN Milk* dairy products, the *Economic Benefits Index* had no significant effect. This suggests that consumers may value the quality aspects of dairy products that are *Made with TN Milk* over local benefits, such as helping farmers or local incomes. For each increase in the level of the *Quality Benefits Index*, the probability of choosing the dairy products that are *Made with TN Milk* increases by 17%. An increase in the level of the Index is projected to increase premiums the consumer would pay by about 13.52%. These results highlight the importance of high-quality locally made processed dairy products over the attribute that the milk is locally sourced. These findings are similar to those from several prior studies (Zepeda and Li, 2006; Gedikoglu and Parcell, 2014; DeLong et al., 2020).

The willingness to pay a premium for local food products (*Premium Local*) increased the probability of choosing dairy products *Made with TN Milk* by 27.20% and WTP premium by 21.60%. Hence, those respondents more willing to pay premiums for local foods, in general, are more likely to pay premiums for dairy products that are made with local milk, suggesting that the *Made with TN Milk* may hold greater appeal to those willing to pay more for local foods. This finding, similar to that from prior research (Zepeda and Leviten-Reid, 2004; Giraud, Bond, and Bond, 2005; Zepeda and Li, 2006; DeLong et al., 2020), suggests that logoed processed dairy products will hold greater appeal to those preferring local foods. Marketing of processed dairy products with the logo might, at least initially, focus on venues where consumers shop most for local foods.

While *TN Milk Logo Familiarity* positively influenced the probability of selecting the *Made with TN Milk* dairy products by 14.4%, the effect on WTP was not significant at the 95% confidence level. This result suggests that those previously unfamiliar with the already existing *TN Milk* logo are willing to pay about the same for the logoed processed dairy products as those more familiar with the *TN Milk* logo. This result does not suggest much brand halo effect from the *TN Milk* logo. However, it is important to keep in mind at the time of this study that the *TN Milk* logo was relatively new. In addition, the *Farm Background* variable did not significantly influence choosing dairy products that are *Made with TN Milk*.

As with DeLong et al. (2020) and Best and Wolfe (2009), demographic variables had no significant effect on willingness to pay for the *Made with TN Milk* logoed products. Age had a negative effect on the probability of purchase up to around 37 years, when the effect became positive. The overall marginal effect of age on the probability of choosing the *Made with TN Milk* dairy products is $f(\boldsymbol{x}'\boldsymbol{\beta})$*($b_{Age}$+2*$b_{Age\ Squared}$**Age*), where $f(\boldsymbol{x}'\boldsymbol{\beta})$ is the logistic density function. This marginal effect value is 0.0057 (95% CI = -0.000, 0.0114), or for each increase in years of age, the probability of choosing *Made with TN Milk* dairy products increases by 0.57%. However, the marginal effect of *Age* on WTP for processed dairy products with the *Made with TN Milk* logo was not significant overall. Neither gender, income, education level, household size, nor race significantly influenced the choice of dairy products purchased. These results suggest that the willingness to pay for processed dairy products with the *Made with TN Milk* logo are fairly consistent across demographics.

Use of the Internet or social media (*Info Internet Social Media*) to obtain information about milk or dairy products significantly influenced the probability of choosing *Made with TN Milk* dairy products by 11.6%. It is possible that Internet and social media users may employ these sources to find out more about locally produced dairy products and ultimately positively influence the likelihood of their choosing these types of dairy products. However, use of information from this source did not significantly influence the WTP at the 95% confidence level.

Shopping for Made with TN Milk Dairy Products at Farmers' Markets and Farm Stores

The variable names, definitions, and means for those used in the estimated logit regression of probability of shopping for *Made with TN Milk* dairy products at a farmers' market or farm stores

are shown in Table 2. As with the sample summary measures reported in Table 1, a greater proportion of the subsample is female than the general population of Tennessee, while the other measures—age, education, and household income—were similar to the Tennessee population.

The estimated logit model of probability of shopping for the *Made with TN Milk* dairy products at farmers' markets/farm stores Pr[$y_{FMKTSTORE} = 1$] is shown in Table 4. As indicated by the log-likelihood ratio the model is significant overall. The model correctly classified 88.26% of the observations. The Pseudo R^2 was 0.1668. The VIF was 5.82, while the Condition Number was 90.44 (as a test, age squared was removed and the Condition Number, again, declined to around 30; hence, the higher condition number was driven by the squared term).

Table 4. Estimated Logit Regression of Probability of Shopping at Farmers' Markets/Farm Stores for Dairy Products that are *Made with TN Milk* (Pr[$y_{FMKTSTORE} = 1$]) among Tennessee Survey Respondents Who Chose *Made with TN Milk* Products

Variable	Estimated Coefficients		Marginal Effect on Pr[$y_{FMKTSTORE} = 1$]	
Intercept	1.782			
Wkly expend	0.003		0.000	
Economic benefits	0.004		0.000	
Quality benefits	0.082		0.008	
TN Milk logo familiarity	0.729		0.072	
Farm background	0.312		0.031	
Female	-0.417		-0.041	
Age	-0.256	***	-0.025	***
AgeSq	0.003	***	0.000	***
Income	0.000		0.000	
College graduate	0.226		0.022	
Household size	-0.032		-0.003	
White race	-0.068		-0.007	
Metro	0.934	*	0.092	*
Info family/friends	0.457		0.045	
Info internet/social media	-0.195		-0.019	
Info store representatives	0.090		0.009	
Shop farmers' markets regularly	0.949	**	0.094	**
Shop local foods	0.914	*	0.090	*
Travel miles GT3	1.012	**	0.100	**
N = 247				
LLR test against intercept only (19 df) = 31.82**				
Pseudo R^2 = 0.1668				
% Correctly classified = 88.26%				
VIF = 5.82				
Condition number = 90.44				

Note: Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels.

As reflected in the estimated marginal effects, many of the household demographics (weekly dairy products expenditures, economic or quality benefits of the products, familiarity with the *TN Milk* logo, farm background, gender) had no influence on the probability of shopping for *Made with TN Milk* processed dairy products at farmers' markets or farm stores. *Age* had a negative effect on the probability of shopping for the products at a farmer's market/farm store up to the age of 49.4 years old, although the overall marginal effect of age was not statistically significant (marginal effect = -0.003 95% CI = -0.006, 0.0004). This finding is in contrast to previous research, which has found a strong linkage between demographics and shopping at farmers' markets or farm stores (Govindasamy et al., 1998; Wolf, Spittler, and Ahern, 2005; Onianwa, Mojica, and Wheelock, 2006; Abello et al., 2013; Gumirizaka, Curtis, and Bosworth, 2014; McGarry Zepeda and Carroll, 2018). Unlike Gumirizaka, Curtis, and Bosworth (2014) and Conner, et al. (2010), economic benefits (e.g., supporting local farmers) was not a strong motivator for shopping for these products at local farmers' markets, potentially indicating that consumers make less of a connection between the farm and more processed products as was suggested by Olynyk and Ortega (2013). Metro residence, shopping for foods at farmers' markets regularly, and shopping for local foods regularly influenced the probability of shopping for the dairy products at farmers' markets and farm stores. Willingness to travel greater than 3 miles out of their way to buy dairy products that are *Made with TN Milk* (*Travel Miles GT3*) increased the likelihood that they would shop for them at farmers' markets or farm stores, which is in contrast to Abello et al. (2013), who found a negative correlation between distance to market and visits. Metro shoppers are 9.21% more likely to shop for the dairy products at a farmers' market or farm store than more suburban or rural shoppers. This result suggests that farmers' markets located in, or around, more metro areas might be considered initial marketing venues to sell processed dairy products with the *Made with TN Milk* logo.

As with Zepeda and Carroll's (2018) findings, those who regularly shop at farmers' markets (*Shop Farmers Markets Regularly*) are 9.36% more likely to shop for the *Made with TN Milk* dairy products at farmers' markets or farm stores than those who do not regularly shop at these outlets. Hence, this suggests that repeat farmers' market shoppers are more likely to shop for the dairy products at these types of outlets. Those who regularly shop for local foods (*Shop Local Foods*) are about 9.02% more likely to shop for the *Made with TN Milk* dairy products at farmers' markets or farm stores than those who do not regularly shop for local foods. Hence, local food shoppers are more likely to seek out these dairy products at farmers' markets or farm stores.

Conclusions

To assist the state's dairy farmers in capturing additional value-added opportunities, in 2018 a Tennessee milk logo, *TN Milk*, was instated. However, this logo only applied to bottled fluid milk, not to dairy products beyond milk. As yet, no state-approved logo identifies processed dairy products that are made using milk from within the state. Hence, additional value-added opportunities might exist by expanding the use of the *TN Milk* logo to dairy products that are made using Tennessee milk, but doing so would require an expansion of the current law enabling the *TN Milk* logo. The purpose of this study was to investigate consumer preferences for a hypothetical logo, *Made with TN Milk*, that indicates a processed dairy product is produced within the state

using Tennessee milk. Findings from this study could inform future policy decisions in Tennessee to expand the scope of the logo used for milk produced in Tennessee as well as the decision to develop logos for processed dairy products in other states.

The results from this study suggest that consumers have an interest in purchasing dairy products, such as cheese, ice cream, butter, sour cream, or yogurt, that are made with *TN Milk*, with about 64.8% indicating interest in purchasing these dairy products at the premiums offered. Results suggest that consumers would be willing to pay about $2.61 additional per week for dairy products with the *Made with TN Milk* logo, which equates to a 23.42% premium. This amount exceeds the 12% premium associated with the logo for fluid milk, *TN Milk,* previously estimated in DeLong et al. (2020). This difference may be because fluid milk is considered more as a necessity than an ingredient in processed products such as cheese or ice cream (Okrent and Alston, 2012), or it could be a result of differences between the respective contingent valuation approaches between the two products. In the milk contingent valuation, a reminder about weekly fluid milk expenditures was not provided, while in the contingent valuation for processed dairy products, a reminder about weekly dairy products expenditures was provided along with what the expenditures would be with purchases of the logoed processed dairy products.

This study examined the willingness of consumers to pay more for dairy product expenditures in the aggregate (cheese, ice cream, sour cream, butter, and yogurt). Additional research should disaggregate these products and examine how consumer preferences for processed dairy products that are made with locally sourced milk vary across the type of dairy product. The purpose of this study was to look at consumer preferences for the logo in the aggregate product grouping. However, additional detail about the effects on WTP for specific logoed products could provide insights into the types of products that might initially be marketed with the logo.

In addition, it is important to note that at the time of this study, the *TN Milk* logo was in its initial phases and many consumers were not familiar with the milk logo. As the milk logo circulates in markets over a longer time period, consumer preferences for a similar logo on dairy products may adjust as there is greater familiarity with the *TN Milk* logo.

Perceived quality benefits, such as freshness, better taste, greater safety, and better for the environment increased WTP, while economic benefits did not add significantly to WTP. Hence, this may suggest that *Made with TN Milk* processed dairy products should be promoted as the basis of improvements to the product by using locally sourced milk. Furthermore, a similar result was found in DeLong et al. (2020)'s study of Tennessee consumers' WTP for locally produced milk. Those selecting to pay premiums for *Made with TN Milk* dairy products are those who tend to be willing to pay premiums for local foods in general.

This study also found that among those interested in purchasing these dairy products, about 13% would likely shop for them at farmers' markets or farm stands. Those interested in shopping for the products at farmers' markets tended to be those who already shop for local foods and already shop at farmers' markets. If farmers' markets and farm store markets serve as an initial market access for dairy products that are made using locally sourced milk, 8.7% more household food

shoppers who at least occasionally consume fluid milk or dairy products (64.8% interested in purchasing logoed products*13.4% would shop for these products at farmers' markets or farm stores = 8.7%) may be attracted to them. Prior research has suggested that the average farmers' market consumer shops farmers' markets about every 1-2 weeks per year (Govindasamy et al., 1998).

This study has several limitations. First, we examined the willingness to pay for a hypothetical logo on dairy products. While we took measures to reduce yea-saying and included a budget reminder, we do not have market data regarding actual prices consumers paid for locally produced dairy products with a *Made with TN Milk* logo. Second, this study focused on one attribute, the *Made with TN Milk* logo. Additional research might extend this study by examining willingness to pay for other dairy product attributes along with the logo in the framework of a choice-based conjoint. In addition, we examined processed dairy products in aggregate, while additional research might examine WTP for the logo on individual dairy products, such as cheese or ice cream, for example. Further, this research represents a snapshot in time. The study was done early in the introduction of the *TN Milk* logo. Hence, many were not familiar with the existing milk logo. Because the milk logo has been on the market for a longer period, consumers' attitudes toward the logo being extended to dairy products could change. Also, it is difficult to extrapolate an overall market potential for dairy products with the *Made with TN Milk* logo, because our sample was limited to primary food shoppers and those who at least occasionally consume milk or dairy products. Hence, several of the demographics of our sample are slightly different from the overall state population averages. In addition, we researched a hypothetical logo; thus, if a logo is implemented that covers dairy products processed locally from milk produced in the state, additional confirmatory research should examine revealed versus stated preferences.

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References

Abelló, F., M. Palma, M. Waller, and D. Anderson. 2014. "Evaluating the Factors Influencing the Number of Visits to Farmers' Markets." *Journal of Food Products Marketing* 20(1):7–35.

Agricultural Marketing Resource Center. 2021. *Dairy Products Profile*. Available online: https://www.agmrc.org/commodities-products/livestock/dairy/dairy-products-profile

Barnes, R., R. Bosworth, D. Bailey, and K. Curtis. 2014. "Connecting Sensory Quality Characteristics and Local Designations to Willingness to Pay for Cheese at the Retail Level." *International Food and Agribusiness Management Review* 17(3):115–138.

Belsley, D.A. 1991. "A Guide to Using the Collinearity Diagnostics." *Computer Science in Economics and Management* 4(1):33–50.

Best, M., and K. Wolfe. 2009. "A Profile of Dairy Consumers in the Southeast and the Potential for Dairies to Market Value-Added Products Locally." *Journal of Food Distribution Research* 3:22–31.

Blamey, R.K., J.W. Bennett, and M.D. Morrison. 1999. "Yea-Saying in Contingent Valuation Surveys." *Land Economics* 75:126–141.

Cronbach, L.J. 1951. "Coefficient Alpha and the Internal Structure of Tests." *Psychometrika* 16:297–334.

Cummings, R.G., and L.O. Taylor. 1999. "Unbiased Value Estimates for Environmental Goods: A Cheap Talk Design for the Contingent Valuation Method." *American Economic Review* 89(3):649–665.

Darby, K. M.T. Batte, S. Ernst, and B. Roe. 2008. "Decomposing Local: A Conjoint Analysis of Locally Produced Foods." *American Journal of Agricultural Economics* 90(2):476–486.

DeLong, K.L., K.L. Jensen, S. Upendram, and E. Eckelkamp. 2020. "Consumer Preferences for Tennessee Milk." *Journal of Food Distribution Research* 51(2):111–130.

Forbes-Brown, S., E. Micheels, and J. Hobbs. 2015. "Signalling Origin: Consumer Willingness to Pay for Dairy Products with the '100% Canadian Milk' Label." Paper presented at the International Conference of Agricultural Economists, Milan, Italy, May 15.

Gedikoglu, H., and J. Parcell. 2014. "Variation of Consumer Preferences between Domestic and Imported Food: The Case of Artisan Cheese." *Journal of Food Distribution Research* 45(2):174–194.

Giraud, K., C. Bond, and J. Bond. 2005. "Consumer Preferences for Locally Made Specialty Food Products Across Northern New England." *Agricultural and Resource Economics Review* 34(2):204–216.

Govindasamy, R., M. Zurbriggen, J. Italia, A. Adelaja, P. Nitzsche, and R. VanVranken. 1998. *Farmers' Markets: Co Trends, Preferences, and Characteristics*. New Brunswick, NJ: Rutgers University, Experiment Station publication P02137-7-98.

Greene, W.H. 2012. *Econometric Analysis*, 8th ed. Boston, MA: Pearson.

Gujarati, D.N., and D. Porter. 2009. *Basic Econometrics*, 5th ed. Boston, MA: McGraw-Hill Irwin.

Gumirakiza, D., K. Curtis, and R. Bosworth. "Who Attends Farmers' Markets and Why? Understanding Consumers and their Motivations." *International Food and Agribusiness Management Review* 17(2):65–82.

McFadden, D. 1974. "Conditional Logit Analysis of Qualitative Choice Behavior." In P. Zarembka, ed. *Frontiers in Economics*. New York, NY: Academic Press, pp. 105–142.

McGarry Wolf, M., A. Spittler, and J. Ahern. 2005. "A Profile of Farmers' Market Consumers and the Perceived Advantages Of Produce Sold at Farmers' Markets." *Journal of Food Distribution Research* 36(1):192–201.

Okrent, A., and J. Alston. 2012. *The Demand for Disaggregated Food Away-from-Home and Food-at-Home in the United States.* USDA Economic Research Service Report Number 1398. Washington, DC: USDA Economic Research Service.

Olynyk, N.J., and D.L. Ortega. 2013. "Consumer Preferences for Verified Dairy Cattle Management Practices in Processed Dairy Products." *Food Control* 30(1):298–305.

Onianwa, O., M. Mojica, and G. Wheelock. 2006. "Consumer Characteristics and Views Regarding Farmers' Markets: An Examination of On-Site Survey Data of Alabama Consumers." *Journal of Food Distribution Research* 37(1):119–125.

Onyango, B., R. Govindasamy, and C. Alsup-Egbers. 2015. "Uncovering Success Attributes for Direct Farmers' Markets and Agri-Tourism in the Mid-Atlantic Region of the United States." *International Food and Agribusiness Management Review* 18(2):63–78.

Schaefer, K. 2019. *Among U.S. Couples, Women Do More Cooking and Grocery Shopping than Men*. Washington, DC: Pew Research Center. Available online: https://pewrsr.ch/2meYzTm.

StataCorp. 2021. Stata Statistical Software, Version 17.0. College Station, TX: StataCorp.

Tennessee Department of Agriculture. 2018. *Support Local Dairies, Look for New Tennessee Milk Logo*. Nashville, TN: Tennessee Department of Agriculture. Available online: https://www.tn.gov/agriculture/news/2018/9/5/tennessee-milk-logo.html.

U.S. Census Bureau. 2020. *Tennessee Demographics*. Available online: https://data.census.gov/cedsci/profile?g=0400000US47&q=Tennessee.

U.S. Department of Agriculture. 2021. *Dairy Products: Per Capita Consumption, United States, Annual*. Washington, DC: Economic Research Service. Available online: https://www.ers.usda.gov/webdocs/DataFiles/48685/pcconsp_1_.xlsx?v=4889.5.

Zepeda, L. 2009. "Which Little Piggy Goes to Market? Characteristics of US Farmers' Market Shoppers." *International Journal of Consumer Studies* 33(3):250–257.

Zepeda, L., and J. Li. 2006. "Who Buys Local Food?" *Journal of Food Distribution Research* 37(3):1–11.

Zepeda, L., and K.A. Carroll. 2018. "Who Shops at a Mature Farmers' Market?" *Choices* 33(3):1–7.

Zepeda, L., and V. Leviten-Reid. 2004. "Consumers' Views on Local Food." *Journal of Food Distribution Research* 35(3):1–6.

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Perceptions of Instituting Nut Bans for Allergy Avoidance

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Abstract

The purpose of this study was to assess where nut bans have been implemented (e.g., schools, workplaces, etc.). Using an online survey of around 1,000 respondents throughout Arkansas, Kansas, Oklahoma, and Texas, we examine which tree nuts have been banned in various locations. Results indicated schools were the most prevalent place nuts were banned, followed by work, then other locations. Further, even though peanuts are most often perceived as the major nut that is banned, respondents reporting bans indicated that all nuts were more likely to be banned than individual nuts.

Keywords: nut allergies, nut bans, nuts in schools, peanuts, tree nuts, food allergies

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Introduction

American consumption of nuts and seeds has been slowly increasing since the USDA began tracking nut consumption in 1970 (Dewey, 2016). Although nut consumption has been increasing since 1970, the pace of growth has increased drastically over the last two decades, especially for almonds and peanuts (Dewey, 2016). Tree nut consumption per capita was only 2.61 pounds in 2000, but it nearly doubled by 2016, rising to 4.7 pounds per capita (Statista, 2016). Meanwhile, peanuts have continued to be the most consumed nut in America, with per capita consumption growing from 6.6 pounds in 2012 to an estimated 7.4 pounds in 2016 (National Peanut Board, 2016).

However, as nut consumption has increased, nut allergies have gained significant public and media attention in recent decades, likely due to an increase in the number of reported allergies as a result of growing consumption. According to the Asthma and Allergy Foundation of America (2018), more Americans are allergic to peanuts than any other food product, which explains why peanut allergens are the leading cause of death by anaphylaxis (Berggren et al., 2017; Asthma and Allergy Foundation of America, 2018). In addition to peanuts, tree nuts—which include almonds, pecans, and cashews, among others—are one of the eight food allergens that account for 90% of all food-allergic reactions (Food Allergy Research and Education, 2018).

Of the estimated 15 million Americans that suffer from food allergies, 5.9 million are children under the age of 18 (Food Allergy Research and Education, 2018), which means that, on average, 1 in 13 children suffers from a food allergy (Food Allergy Research and Education, 2018). The Centers for Disease Control and Prevention reported that food allergies in children increased in prevalence by 50% from 1997 to 2011, while the prevalence of peanut and tree nut allergies appears to have more than tripled from 1997 to 2008 (Food Allergy Research and Education, 2018). In fact, recent research presented by the American College of Allergy, Asthma, and Immunology (2017) suggests that peanut allergies in children have increased by 21% since 2010, while tree nut allergies increased 18% over the same period (American College of Allergy, Asthma, and Immunology, 2017). As noted by Warren et al. (2021), peanut allergies impacted 4.6 million adults in the United States in 2020.

The recent increase in the prevalence of nut allergies has resulted in nut bans in many public places like schools and airplanes. Allergic reactions caused by nuts, especially peanuts, have serious symptoms such as throat tightness and shortness of breath, which can often lead to anaphylactic shock. In many cases, these reactions have been triggered by mere exposure or proximity to nut products, not just personal consumption. Because these symptoms are so severe and the reactions can occur from proximity alone, many schools have completely banned peanut products from being distributed in school cafeterias or brought in students' lunches from home.

The intent of this study is to identify who (e.g., individuals, family, society, schools, local governments, federal government, etc.) should have responsibility for allergy avoidance as well as to improve understanding of trends involving nut bans in public places like schools, workplaces, and airplanes and gauge the public perception of those bans. Notably, we assess where nut products

are most often banned, which types of nuts are targeted most, and how the public perceives restrictions on public nut consumption. Results can help inform nut producers, retailers, and policymakers on making policy decisions based on public sentiment.

Literature Review

The growing public concern over food allergies, especially those in school-aged children, has led to many scientific and observational studies on the issue. For instance, Nowak-Wegrzyn, Conover-Walker, and Wood (2001) conducted a telephone survey of parents with food-allergic children, asking a series of questions about their child's history of allergic reactions in school. The schools were then contacted so that the person responsible for treating allergic reactions could be surveyed as well. Of the children surveyed with allergies, 75% had a peanut allergy, 46% had a tree nut allergy, and 75% suffered from two or more food allergies, implying there is considerable overlap between those who are allergic to peanuts and those who are allergic to tree nuts (Nowak-Wegrzyn, Conover-Walker, and Wood, 2001). Furthermore, peanuts were the most common cause of reactions in school-aged children, with 24% of the reactions occurring in schools that made special accommodations to prevent allergic reactions, highlighting the difficulty involved with completely eliminating the threat of food-allergic reactions in schools (Conover-Walker, Nowak-Wegrzyn, & Wood, 2001).

Young, Munoz-Furlong, and Sicherer (2009) explored the potential of casual skin contacts and inhalation exposures to cause life-threatening reactions. There is a widespread public fear that peanut allergies can be so severe that anaphylaxis can occur simply from skin contact or airborne exposure. The study concludes that peanuts and peanut butter at room temperature have a distinct aroma but have no significant vapor phase that contains a peanut protein capable of causing a reaction. Food allergy reactions are immunologic responses to food protein allergens and not just the odors of the food, so there is no threat of anaphylaxis due to airborne exposure to peanuts (Young, Munoz-Furlong, and Sicherer, 2009). Ma et al. (2003) performed a double-blind, placebo-controlled study to test for the possibility of reaction to peanuts from skin contact. They concluded with 95% confidence that the possibility of anaphylaxis was remote for 90% of children with a peanut allergy who were exposed to peanut butter through skin contact or inhalation.

The results of these studies seem to discount the necessity for any kind of schoolwide bans on peanut products. However, there are no studies that directly examine the incidence of allergic reactions to peanuts in schools with peanut bans versus schools without bans and no studies that look at the possibility of reactions due to airborne or skin contact with tree nuts. Therefore, whether or not peanut and tree nut consumption bans should be imposed in schools and other public places remains a relevant issue and one that is largely debated by the public.

Another key point of debate with the issue of food allergies in schools is how responsibility for management of the allergies should be shared between parties, including parents, children, teachers, and school nurses. Young, Munoz-Furlong, and Sicherer (2009) identified deficiencies in the prevention and treatment of food allergies in schools and discussed the responsibilities of families, schools, and students to better manage and prevent allergic reactions. A 1992 study on fatal and

near-fatal food-induced anaphylaxis in children found that 4 out of 6 fatal reactions that occurred in schools were associated with significant delays in treatment with epinephrine; the mean treatment time for epinephrine was 75 minutes and none of the students received epinephrine sooner than 22 minutes after the show of symptoms (Mendelson, Rosen, and Sampson, 1992). Young, Munoz-Furlong, and Sicherer (2009) referenced this 1992 study as the driving force prompting investigation of food allergy management plans and policies in schools. These investigative studies primarily identified two main deficiencies in food allergy care in schools and childcare settings: inadequate food allergy management plans and deficiencies in recognizing reactions and treating them promptly.

Allergy management plans include a written emergency action plan, which outlines a general or individualized plan for reaction prevention and delineates medical treatment for an allergic reaction for that specific individual. An earlier study by Sicherer et al. (2001) found that out of 100 randomly selected children registered in the U.S. Peanut and Tree Nut Allergy Registry, an emergency action plan was in place in only 33% of the cases. Ensuring that each child with food allergies has an emergency action plan on file with the school should be the responsibility of the child's parents. However, in cases when there was an emergency action plan in place and the student suffered a reaction, the plan was followed only 73% of the time (Young, Munoz-Furlong, and Sicherer, 2009). Another referenced study of 47 schools in Indianapolis found that 53% of the schools had no policy for management of anaphylaxis and the other 47% had a policy that consisted only of calling 911 (Young, Munoz-Furlong, and Sicherer, 2009). Sicherer et al. (2001) also found that for children in the U.S. Peanut and Tree Nut Allergy Registry, school personnel failed to recognize the symptoms of an allergic reaction in 32% of the cases. These findings highlight the lack of responsible health and safety management practices in many schools throughout the United States. These results also raise an important question regarding the share of responsibility between involved parties in preventing and treating allergic reactions, which will be explored further in this paper.

Materials and Methods

The purpose of this study was to gauge which nut products are being banned in order to reduce the risk of allergic reactions and in which public places they are banned most often. In addition, the study will determine the general public's perception of how the responsibility of allergy avoidance should be shared by involved parties. It is hypothesized that nuts will be banned in school settings more often than in workplaces and other locations and that peanuts will be banned more frequently than any other type of nut.

An online survey was constructed and distributed in November 2019 to panelists in the Toluna, Inc. database. Toluna, Inc. is an online panel provider that has millions of panelists within their database. The survey focused on a wide variety of nut topics, including drivers of purchasing nut products, previous nut purchases, as well as experience with nut bans and responsibility for avoiding foods causing allergies. The survey received around 800 responses from both buyers and nonbuyers of nut products in Arkansas, Kansas, Oklahoma, and Texas. These states were chosen given the interests of the grant entity (a producer/retailer that predominately markets products in

the states surveyed), notably to assess respondents' valuation of local labels on various nut products, usage and barriers to nut consumption, and policies associated with nuts. Survey participants had to be at least 18 years of age with both buyers and non-buyers of nut products sampled.

Overall, the sample was fairly representative of the states in terms of demographics (see Table 1). Respondents had a lower median household income ($35,000) compared to the 2019 Census estimate for the states surveyed ($59,684) (United States Census Bureau, 2021b). The median age of individuals in the states surveyed was 36 in 2019 according to Census data, while the median age of respondents was 49 (United States Census Bureau, 2021c); the slightly higher sample median can be attributed to the fact that minors were ineligible to complete the survey. Females were oversampled (72% to Census estimate of 50%) (United States Census Bureau, 2021b), given they have been shown to be the primary food shoppers in a majority of households (Zepeda, 2009; Flagg et al., 2013; Wolfe, 2013;). In terms of race, the sample was composed of 82% Caucasian, which is comparable to the Census estimate of 79% Caucasian in the states sampled (United States Census Bureau, 2021b). From an education standpoint, the highest percentage of respondents had received some college credit (39.1%), followed by a high school diploma or less (31.3%), a bachelor's degree (19.3%), and education beyond a bachelor's degree (10.3%). Census estimates for 2019 indicate 39% having an education level of high school or less, 27% having some college or associate's degree, 22% having a bachelor's degree, and 13% having higher than a bachelor's degree (United States Census Bureau, 2021a). As a caveat, results can only be generalized to populations insomuch as the sample is comparable to the demographics, nut ban experiences, and views on allergy responsibility of populations outside the sample. There is no way to definitively state that our sample meets these criteria to generalize outside of the sample.

With respect to the questions of interest, the survey first asked about allergies in the household, then whether nuts were banned in any of the following places that the respondent or his/her family frequented, with the response options being "your child's school," "where you work," "other," or "nuts are not banned." If the respondent selected any option other than "nuts are not banned," they were directed to a follow-up question that asked which types of nuts were the targets of the ban: all nuts, cashews, almonds, peanuts, walnuts, pecans, hazelnuts, or other. All respondents were then asked if airlines should ban nuts on their flights, with the response options being "only domestic flights," "only international flights," "all flights," "only if someone on the plane has indicated they have a nut allergy," and "airlines should not ban nuts on flights." Lastly, respondents were asked, on a scale of 0 = "no responsibility" to 100 = "full responsibility," how much responsibility the following groups should have in helping allergy sufferers avoid the allergy: "person with the allergy," "family of person with the allergy," "society as a whole," "school," "workplace," "restaurant," "city/local governments," "playgrounds," "federal government," and "other public locations."

Table 1. Demographic Composition of Sample

Demographic	Mean	Std. Dev.
Age (mean)	49.0	17.7
Age (median)	49	
Household income (mean) $	$50,469	$41,341
Household income (median) $	$35,000	
Children in household	0.7	1.1
Adults in household	2.2	1.0
BMI	29.7	8.6
Primary or equal shopper?		
Yes	95%	
No	5%	
Gender		
Male	28%	
Female	72%	
Race		
White	81.5%	
Other	18.5%	
Community type		
Rural	41%	
Suburban	39%	
Urban	20%	
Education		
High school or less	31.3%	
Some college	39.1%	
Bachelors	19.3%	
Graduate/Prof.	10.3%	
Age by generation		
Older (Baby Boomers+)	49%	
Gen X	32%	
Younger (Millennials & Gen Z)	19%	

Given the central goal of this paper was to better understand the public perception of how responsibility should be shared by various parties in avoiding allergic reactions due to the public consumption of nut products, the responsibility variable was assigned by each respondent on a 0-100 scale, where responses were observed as not responsible at all (0), full responsibility (100), or anywhere in between. Given the censoring of the scale on both ends, the two-limit Tobit model developed by Rossett and Nelson (1975) was used. The model can be represented as:

$$y^*_i = \beta' x_i + \varepsilon_i \ (i = 1, \ldots, n) \quad (1)$$

$$y_i = \begin{cases} 0 & if\ y_i^* \leq 0 \\ y_i^* & if\ 0 < y_i^* < 100 \\ 100 & if\ y_i^* \geq 100 \end{cases} \qquad (i = 1, \ldots, n)$$

where y_i* is an unobserved latent variable for values below 0 and above 100, x is a demographics, nut purchasing, a health indicator, and a food neophobia index, β represents a vector of coefficients, and ε is an independently and normally distributed error term with zero mean and variance σ^2. Coefficients can be obtained by maximizing the likelihood function in equation two (Davidson and McKinnon, 1993, p. 541):

$$\sum_{y_i^L \leq y_i^* \leq y_i^U} log\left(\frac{1}{\sigma}\emptyset\left(\frac{1}{\sigma}(y_i - x_i\beta)\right)\right) + \sum_{y_i^* < y_i^L} log\left(\phi\left(\frac{1}{\sigma}(y_i^L - x_i\beta)\right)\right) +$$

$$\sum_{y_i^* > y_i^U} log\left(\phi\left(-\frac{1}{\sigma}(y_i^U - x_i\beta)\right)\right) \quad (2)$$

where *i* is the respondent, *L* represents the lower bound, *U* represents the upper bound, and "the first term corresponds to nonlimit observations, the second term to observations at the lower limit y_t^L, and the third to observations at the upper limit y_t^U." (Davidson and McKinnon, 1993, p. 541). As noted by Gould, Saupe, and Lemme (1989), the β coefficients are not interpretable as the marginal effects of a change in an independent variable. Utilizing the McDonald and Moffitt decomposition extension for 2-limit censoring, we calculate and discuss the marginal effects conditional on being uncensored.

Analysis and Results

Nut Allergy Prevalence and Purchasing Patterns

In order to most accurately gauge respondents' perceptions of public nut consumption bans, survey respondents included both purchasers and non-purchasers of nut products, as well as individuals with and without nut allergies. A majority (93%) of respondents did not report any personal nut allergies or allergies within their households, while 3.8% reported that they had an allergy themselves, and 3.2% noted that someone else in their household was allergic to nuts (see Table 2). Compared to the U.S. population, estimates for peanut and tree nut allergies in the United States range from 1% to 3% (Gupta et al., 1999; Sicherer et al., 1999). A majority (84.4%) of the respondents were nut purchasers who did not have allergies within their households. Only 8.6% of respondents did not purchase nut products even though no one in the house was allergic, and 1.7% did not purchase and someone in the household was allergic. Interestingly, 5.3% of respondents purchased nut products even though there was an individual living in the house who had a nut allergy.

Of the respondents who indicated there was someone with a nut allergy in their household, 43% indicated the individual was allergic to all nut types (see Table 2). Selecting the "all" response automatically selected the response for each individual nut type as well. The individual nut types included as response options were cashews, almonds, peanuts, walnuts, pecans, hazelnuts, and a write-in "other" option. As expected, peanuts had the highest rate of reported allergies with 38%. Almonds had the next highest percentage of allergies with 24%, followed closely by walnuts with 22%. Those respondents who had a nut allergy (19%) indicated pecans as the culprit, while 16% were allergic to cashews, 15% were allergic to hazelnuts, and 7% indicated "other" nuts.

Table 2. Nut Allergy Prevalence and Purchase Information

Prevalence of Nut Allergies among Respondents	
Response Option	**% of Respondents**
No allergy	93.0
Personal allergy	3.8
Allergy in household	3.2
Purchasing Patterns in Allergic and Non-Allergic Households	
Response Option	**% of Respondents**
Purchased, no allergy	84.4
Purchased, allergy	5.3
Not purchased, allergy	1.7
Not purchased, no allergy	8.6
Allergies by Type of Nut in Respondents Indicating an Allergy	
	% of Respondents with an Allergy that are Allergic to Specific Nut Type*
Nut Type	
All types of nuts	43
Cashews	16
Almonds	24
Peanuts	38
Walnuts	22
Pecans	19
Hazelnuts	15
Other	7

*These do not sum to 100% due to the inclusion of "All" and "Other" response options.

Location of Nut Bans

A majority of respondents (82%) indicated they had not encountered nut bans (see Table 3). However, 14% indicated they had encountered nut bans at their child's school, with another 3% at work, and 2% at some other location. Though 14% does not seem like a huge percentage, in 2019 that amount would have meant that 1 million students in the four states surveyed were impacted by school nut bans (United States Census Bureau, 2021b).

Table 3. Bans by Location

Location of Ban	% Encountering Ban
No bans encountered	82
School	14
Work	3
Other	2

Airline Nut Bans

For decades a main snack available on airplanes has been nuts, particularly peanuts. As nut allergies have increased, airlines have changed what they serve as snacks. For instance, American Airlines, JetBlue Airways, and United do not serve peanuts in flight, and Delta Air Lines and Southwest will not serve peanuts if notified in advance of the flight. American Airlines and JetBlue Airways serve non-peanut nut alternatives, with none of the five major airlines noted above guaranteeing no nuts or cross-contamination of any of their snacks or meals (Bradley, 2020).

These proactive measures by airlines are contrary to what respondents in our sample indicated should happen. A majority (58%) of sample respondents indicated there should be no nut ban on flights, with another 27% indicating nut bans should only be enacted on a given flight if an allergy was indicated by a passenger (see Table 4). Only 11% of respondents noted nut bans should be on all flights.

Table 4. Perceptions of Airline Flight Bans

Response Option	% of Respondents
No flight bans	58
Allergy indicated	27
All flights	11
Only domestic	2
Only international	1

Responsibility Levels Assigned to Parties Involved with Allergy Avoidance

Having acquired a general understanding of the prevalence and types of nut allergies present in the sample, we sought to develop a more thorough understanding of how the public perceives nut bans by asking the amount of responsibility certain groups should have in preventing public allergic reactions. Respondents were instructed to assign a responsibility rating to each party in a list of those with potential involvement in allergy avoidance (i.e., individual, family, society, school, workplace, restaurants, local government, playgrounds, federal government, and other). The parameters for the rating were 0 (no responsibility) to 100 (full responsibility), and respondents could assign a rating of any number in between. The average responsibility rating assigned for each group by the sample as a whole was calculated and recorded in Table 4.

Individuals were noted as "should be taking the highest responsibility for allergy avoidance" (91.2), followed by "family" (86.7). All other groups had lower mean scores with schools (69.5) and restaurants (68.0) in the next grouping, with all other groups at 52.3 or less on the responsibility scale. Given the disparity in mean scores, it seems clear that respondents value individuals and their families taking the lead in avoiding allergies with other groups having lower responsibility levels.

Tobit Model, Conditional on Being Uncensored

Though the means provided in Table 4 are interesting, other factors such as demographics, nut purchasing levels, etc., are likely to play a role in whom a respondent feels should be responsible.

Nongovernmental Entities

The results for nongovernmental entities (i.e., individuals, family, society, schools, workplace, restaurants) are interesting (see Table 5). For instance, Millennial/younger respondents had responsibility ratings 2.9% and 8% lower than Baby Boomers and older respondents for individuals and family, respectively. However, Millennial/younger respondents had 4.3% higher ratings for a restaurant's responsibility for allergy avoidance.

Table 5. Responsibility Level of Allergy Avoidance by Varying Entities

Group	Mean	Std. Dev.
Individual	91.2	19.1
Family	86.7	21.9
Society	52.3	30.5
School	69.5	28.4
Workplace	52.0	31.5
Restaurant	68.0	28.2
Local govt	47.3	31.3
Playgrounds	47.9	33.1
Federal govt	48.2	32.3
Other	47.4	31.3

Males (compared to females) had lower ratings for both individual and family responsibility, though households with a greater number of adults had higher ratings. Caucasian respondents had higher ratings for individual responsibility, but lower scores for society and the workplace. Respondents with lower education levels (high school or less) rated individual responsibly lower, but had higher ratings for society, workplaces, restaurants, and other.

With respect to purchasing, respondents that had not purchased and were not allergic in the household rated individuals, family, workplaces, restaurants, and other entities lower than respondents who had purchased but were not allergic. Respondents that had purchased and were allergic perceived individual responsibility as lower while viewing workplaces as having more responsibility.

Governmental Entities

When examining governmental entities (local governments, playgrounds, federal government, schools), education, race, and purchasing had effects across multiple entities (see Table 6). Caucasian respondents were less likely to place responsibility on local governments, playgrounds, and the federal government. However, less educated (high school or less) respondents placed more responsibility on all of the governmental entities evaluated. Respondents who had purchased but were allergic were more likely to place responsibility on local governments, playgrounds, and the federal government, while non-purchaser/non-allergic respondents were less likely to place responsibility on local governments, the federal government, and schools.

Table 6. Marginal Effects from the Tobit Models for Non-Governmental Entities

	Conditional on being Uncensored											
	Individual		Family		Society		Workplace		Restaurant		Other	
	dy/dx	p-value	dy/dx	p-value	dy/dx	p-value	dy/dx	p-value	dy/dx	p-value	dy/dx	p-value
State												
Oklahoma	**3.978**	**0.004**	2.461	0.106	0.885	0.881	-1.719	0.435	**3.523**	**0.083**	0.731	0.747
Kansas	2.017	0.272	2.372	0.244	-1.285	0.669	-3.545	0.225	0.036	0.989	-2.488	0.413
Arkansas	**3.768**	**0.049**	1.797	0.384	-0.031	0.992	-4.237	0.154	4.275	0.120	2.155	0.483
Texas	--	--	--	--	--	--	--	--	--	--	--	--
Generation												
Older (baby boomer and older)	--	--	--	--	--	--	--	--	--	--	--	--
Gen X	-1.893	0.127	**-5.700**	**0.000**	-0.293	0.881	3.048	0.113	1.245	0.481	-0.104	0.959
Younger (millennial and younger)	**-2.863**	**0.045**	**-8.027**	**0.000**	-1.046	0.649	2.754	0.217	**4.264**	**0.041**	1.907	0.418
Gender												
Male	**-2.170**	**0.057**	**-2.806**	**0.023**	-1.206	0.516	-1.720	0.341	-0.280	0.867	-0.960	0.609
Female	--	--	--	--	--	--	--	--	--	--		--
Primary or equal shopper?												
Yes	-3.060	0.216	0.398	0.876	-5.386	0.182	-3.820	0.314	-1.198	0.736	-1.239	0.753
No	--	--	--	--	--	--	--	--	--	--	--	--
FNS	**-0.105**	**0.019**	**-0.128**	**0.007**	0.045	0.526	-0.001	0.988	-0.090	0.157	0.091	0.199
Community Type												
Rural	0.899	0.490	0.227	0.872	**-4.689**	**0.027**	-2.770	0.188	**-3.674**	**0.056**	**-4.758**	**0.030**
Suburban	2.041	0.119	**2.335**	**0.097**	-2.586	0.219	-1.985	0.338	-0.327	0.864	**-4.178**	**0.051**
Urban	--	--	--	--	--	--	--	--	--	--	--	--
Adults in household	**1.040**	**0.045**	**1.349**	**0.015**	0.125	0.875	-0.818	0.299	0.107	0.882	-0.039	0.961
Children in household	0.551	0.297	0.863	0.125	0.728	0.382	-0.831	0.314	-0.424	0.568	0.897	0.290
Race												
Caucasian	**3.949**	**0.002**	1.019	0.458	**-3.846**	**0.061**	**-4.583**	**0.023**	-0.660	0.723	-3.770	0.075
Other	--	--	--	--	--	--	--	--	--	--	--	--

Table 6. (cont)

	Conditional on being Uncensored											
	Individual		**Family**		**Society**		**Workplace**		**Restaurant**		**Other**	
	dy/dx	*p*-value	dy/dx	*p*-value	dy/dx	*p*-value	dy/dx	*p*-value	dy/dx	*p*-value	dy/dx	*p*-value
Education												
High school or less	**-2.674**	**0.078**	-2.346	0.147	**5.820**	**0.014**	**5.567**	**0.017**	**6.114**	**0.004**	**5.722**	**0.020**
Some college	-0.616	0.660	-0.159	0.915	2.090	0.338	0.030	0.989	**4.170**	**0.033**	0.609	0.785
Bachelors	--	--	--	--	--	--	--	--	--	--	--	--
Grad/prof	-2.026	0.313	-0.122	0.955	**7.810**	**0.015**	0.883	0.776	4.617	0.106	4.703	0.144
Household income	0.000	0.903	-0.000	0.358	-0.000	0.575	-0.000	0.313	-0.000	0.252	-0.000	0.436
BMI	0.026	0.634	0.034	0.559	0.024	0.779	-0.057	0.496	0.001	0.993	0.007	0.938
Purchased, allergic	**-7.216**	**0.001**	-3.390	0.161	5.565	0.145	**6.744**	**0.071**	4.360	0.222	6.121	0.112
Not purchased, allergic	2.535	0.545	-0.952	0.816	-5.022	0.385	4.176	0.531	-3.314	0.571	-3.980	0.550
Not purchased, not allergic	**-3.426**	**0.035**	**-4.385**	**0.013**	-4.417	0.121	**-4.984**	**0.065**	**-6.039**	**0.013**	**-4.905**	**0.087**
Purchased, not allergic	--	--	--	--	--	--	--	--	--	--	--	--
Observations	625		621		589		586		614		547.000	
LR Chi square	66.74		74.24		29.40		35.31		39.06		36.010	
Prob. > Chi square	0.0000		0.0000		0.1047		0.0261		0.0096		0.022	
Log likelihood	-1266.86		-1768.22		-2635.562		-2579.655		-2502.044		-2460.013	
Pseudo R square	0.0257		0.0206		0.0055		0.0068		0.0077		0.007	

Note: Bold indicates significance at the 0.10 level or less.

Implications and Conclusions

The move to address nut allergies throughout the population has led some workplaces, airlines, and schools to embrace nut bans. As such, understanding the prevalence of these bans and how people view responsibility for avoiding allergens is essential. We found that a large portion of respondents who have a nut ban are allergic to all nuts, with peanuts being the most cited nut causing an allergic reaction. Furthermore, we found that only 18% of our sample had encountered a nut ban, with 14% of those respondents having encountered the ban in schools. These findings show that nut bans are not prevalent (though they do impact a large number of people) or have not been noticed by our survey respondents.

With respect to airlines, 58% of respondents noted nuts should not be banned in flights. This is different from the approach that three (American Airlines, JetBlue Airways, and United) of the five biggest airlines (American Airlines, JetBlue Airways, United, Delta Air Lines, and Southwest) have taken to ban nuts. Notably, only 14% of respondents want a complete or partial ban (domestic or international flights), which is the approach that American Airlines, JetBlue Airways, and United have taken. As firms make and/or modify their policies surrounding banning nuts, they must examine the impact the ban has on their finances as well as the risk of allowing nuts on planes.

With respect to responsibility, overall, survey respondents indicated individuals and families should be the primary entities responsible for allergy avoidance. Schools and restaurants score in the higher responsibility for allergy avoidance realm, though lower than individuals and families. However, there is a disparity in which demographics view whom should be responsible for allergy avoidance. Notably, younger respondents felt less strongly that individuals and families should be responsible for avoiding allergies than Baby Boomers.

Given these findings, it is clear that nut bans are a divisive issue in terms of where they should be enacted. As such, when considering whether to enact a nut ban, firms and policymakers should weigh the impacts of nut bans on allergic individuals against the impacts on agricultural producers and the finances of enacting a ban. From the producer perspective, the results indicate that nut bans may not be widespread because many respondents had not encountered a nut ban. Policy makers and retailers' decisions about enacting nut bans may be contrary to what the general public perceives as needed, given self-responsibility was the primary entity viewed as responsible for allergy avoidance.

References

American College of Allergy, Asthma, and Immunology. 2017. *New Study Suggests 21 Percent Increase in Childhood Peanut Allergy since 2010*. Available online: https://acaai.org/news/new-study-suggests-21-percent-increase-childhood-peanut-allergy-2010.

Asthma and Allergy Foundation of America. 2018. *Allergy Facts and Figures*. Available online: http://www.aafa.org/allergy-facts/.

Berggren, T., C. Lee, J. Yoo, R. Scherr, and S. Zidenberg-Cherr. 2017. *Nutrition and Health Info Sheet: Food Allergies*. Available online: https://cns.ucdavis.edu/sites/g/files/dgvnsk416/files/inline-files/food-allergy-professional-2017.pdf.

Davidson, R., and J.G. McKinnon. 1993. *Estimation and Inference in Econometrics*. New York: Oxford University Press.

Dewey, C. 2016. "The American Diet Hasn't Changed in Years – Except for this One Thing." *The Washington Post.* Available online: https://www.washingtonpost.com/news/wonk/wp/2016/12/30/the-american-diet-hasnt-changed-in-years-except-for-this-one-thing/?utm_term=.a68a7c818789.

Flagg, L.A., B. Sen, M. Kilgore, and J.L. Locher. 2013. "The Influence of Gender, Age, Education, and Household Size on Meal Preparation and Food Shopping Responsibilities." *Public Health Nutrition* 17(9):2061–2070.

Food Allergy Research and Education. 2018. *Facts and Statistics*. Available online: https://www.foodallergy.org/life-with-food-allergies/food-allergy-101/facts-and-statistics

Gupta, R.S., C.M. Warren, B.M. Smith, J. Jiang, J.A. Blumenstock, M.M. Davis, R.P. Schleimer, and K.C. Nadeau. 2019. "Prevalence and Severity of Food Allergies among US Adults." *Journal of the American Medical Association Network Open* 2(1):1–14.

Ma, S., M. Shideh, S. Sicherer, and S. Simonte. 2003. "Relevance of Casual Contact with Peanut Butter in Children with Peanut Allergy." *The Journal of Allergy and Clinical Immunology* 112(1):180–182.

Mendelson, L., J. Rosen, and H. Sampson. 1992. "Fatal and Near-Fatal Anaphylactic Reactions to Food in Children and Adolescents." *The New England Journal of Medicine* 327(6):380–384.

National Peanut Board. 2016. *Here's the Shocking Number of Peanuts You Eat Every Year*. Available online: http://www.nationalpeanutboard.org/news/heres-the-shocking-number-of-peanuts-you-eat-every-year.htm.

Nowak-Wegrzyn, A., M.K. Conover-Walker, and R.A. Wood. 2001. "Food-Allergic Reactions in Schools and Pre-Schools." *Archives of Pediatrics and Adolescent Medicine* 155(7):790–795.

Rossett, R.N., and F.N. Nelson. 1975. "Estimation of the Two-Limit Probit Regression Model." *Econometrica* 43(1):141–146.

Sicherer, S.H., A. Muñoz-Furlong, A.W. Banks, and H.A. Sampson. 1999. "Prevalence of Peanut and Tree Nut Allergy in the US Determined by a Random Digit Dial Telephone Survey." *Journal of Allergy Clinical Immunology* 103(4):559–562.

Sicherer, S.H., T.J. Furlong, J. DeSimone, and H.A. Sampson. 2001. "The US Peanut and Tree Nut Allergy Registry: Characteristics of Reactions in Schools and Day Care." *The Journal of Pediatrics* 138(4):560–565.

Statista. 2016. *Per Capita Consumption of Tree Nuts (Shelled) in the United States from 2000 to 2016 (in pounds)*. Available online: https://www.statista.com/statistics/184216/per-capita-consumption-of-tree-nuts-in-the-us-since-2000/.

U.S. Census Bureau. 2021a. *Educational Attainment in the United States: 2019*. Available online: https://www.census.gov/data/tables/2019/demo/educational-attainment/cps-detailed-tables.html.

U.S. Census Bureau. 2021b. *QuickFacts: Texas; Oklahoma; Kansas; Arkansas; United States.* Available online: https://www.census.gov/quickfacts/fact/table/TX,OK,KS,AR,US/PST045221.

U.S. Census Bureau. 2021c. *State Population by Characteristics: 2010–2019*. Available online: https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-detail.html#par_textimage_785300169.

Warren, C., D. Lei, S. Sicherer, R. Schleimer, and R. Gupta. 2021. "Prevalence and Characteristics of Peanut Allergy in U.S. Adults." *The Journal of Allergy and Clinical Immunology* 147(6):2263–2270.

Wolfe, A. 2013. "Christine Lagarde: On Top of the World." *The Wall Street Journal*. Available online: https://www.wsj.com/articles/SB10001424052702303918804579109200647077052.

Young, M.C., A. Muñoz-Furlong, and S.H. Sicherer. 2009. "Management of Food Allergies in Schools: A Perspective for Allergists." *The Journal of Allergy and Clinical Immunology* 124(2):175–182.

Zepeda, L. 2009. "Which Little Piggy Goes to Market? Characteristics of US Farmers' Market Shoppers." *International Journal of Consumer Studies* 33(3):250–257.