Linking Consumer Health Perceptions to Consumption of Nonalcoholic Beverages

Hyeyoung Kim and Lisa A. House

This study explored factors influencing consumers' beverage consumption. Consumers drank greater shares of beverages perceived as healthy and, in most cases, drank smaller shares of a beverage when they perceived alternative beverages as more healthy. One exception was carbonated sugar-sweetened beverages; the share of their consumption increased as health perceptions of 100 percent juice increased and vice versa. Another important determinant of beverage consumption share was objective and subjective health knowledge. Beverage drinking habit, which was measured by whether a beverage was consumed daily or weekly, was the most significant factor in explaining a beverage's diet share.

Key Words: beverage, consumption, perception, sugar

Consumers are faced with beverage selection decisions every day. These decisions are of particular interest because sugar-sweetened beverages (SSBs) have been generally associated with obesity and a greater risk of developing diabetes (DiMeglio and Mattes 2000, Schulze et al. 2004, Mattes 2006). Schulze et al. (2004) found that increased consumption of fruit juice had a significant impact on weight gain but that the effect was not dramatic compared with soft drinks. They also found that, unlike intake of sugar-sweetened soft drinks, intake of fruit juice was not associated with an increased risk of type 2 diabetes. Links between consumption of beverages and certain health conditions vary with consumers' lifestyle choices, including level of physical activity (Carels, Konrad, and Harper 2007, Pereira and Fulgoni 2010).

Several studies have found that consumers' beverage drinking habits are closely linked to overall health, socioeconomic status, and lifestyle. For example, Storey, Forshee, and Anderson (2006) found that beverage consumption patterns varied with demographic characteristics: (i) energy (calories) obtained from beverages increased until age 39 and then decreased after age 40; (ii) women obtained less of their energy intake from beverages

Hyeyoung Kim is a postdoctoral associate in the Food and Resource Economics Department at University of Florida, Gainesville. Lisa A. House is a professor in the Food and Resource Economics Department at University of Florida, Gainesville. Corresponding Author: *Lisa House ▪ Food and Resource Economics Department ▪ University of Florida ▪ PO Box 110240 ▪ Gainesville, FL 32611-0240 ▪ Phone 352.294.7653 ▪ Email lahouse@ufl.edu.*

Support for this research was provided by the Florida Department of Citrus.

This paper is included as part of the special issue of *ARER* related to the workshop "Beverage Markets and Policy" organized by the Northeastern Agricultural and Resource Economics Association (NAREA) in Ithaca, New York, on June 22 and 23, 2013. The workshop received financial support from the Food and Agricultural Marketing and Policy Section of the Agricultural and Applied Economics Association, the Food Industry Management Program at Cornell University, and Zwick Center for Food and Resource Policy at University of Connecticut. The views expressed are the authors' and do not necessarily represent the policies or views of the sponsoring agencies.

than men; (iii) Caucasians drank less fruit juice and fruit drinks and more milk than African Americans; (iv) Caucasians drank more sugar-sweetened soft drinks than African Americans up to age 39; and (v) Caucasians drank more diet soft drinks than any other race/ethnicity group. Popkin (2010) showed that middle-aged adults consumed less water and more unsweetened tea and coffee and diet beverages than any other age group.

Researchers have long been interested in exploring the reasons for consumer actions in general and links between consumer attitudes and behavior in particular. Some studies have found little relationship between attitudinal predictors and behavioral criteria (Wicker 1969, Liska 1975, Brannon 1976) since attitudes are only one of many factors that determine behavior (Ajzen and Fishbein 1977). However, following Ajzen's (1991) theory of planned behavior, attitudes toward a behavior, subjective norms, and perceived behavioral controls all may influence a person's behavioral intentions and can be expected to correlate with behavior. Similarly, other theorists have asserted that behavioral and perceptual representations are closely interconnected in terms of memory (Chartrand and Bargh 1999, Bargh 2003).

Researchers have found that consumers' knowledge of various characteristics associated with food significantly influences their food choices (Tepper, Choi, and Nayga 1997, Kolodinsky et al. 2007). In particular, it is common to find differences between a consumer's subjective (self-rated) and objective (tested) knowledge (Ruddell 1979, Brucks 1985, Park, Mothersbaugh, and Feick 1994). House et al. (2004) found that consumer acceptance of genetically modified foods, for example, was more closely related to what consumers believed than to what they actually knew. Participants' beliefs, later shown to be incomplete or inaccurate, still influenced their consumption decisions. Consumer knowledge often is used in studies to indicate the effect of education efforts. We consider consumers' knowledge, both objective and subjective, to measure the effect of nutrition education on beverage consumption.

While many previous studies have examined beverage drinking patterns, few have explored links between those patterns and consumers' perceptions of the healthiness of the beverages. Zoellner et al. (2012) and Bruijn and Putte (2009) applied the theory of planned behavior (Ajzen 1991) to identify factors influencing SSB consumption while excluding important explanatory variables such as environmental or economic factors that could influence a person's intention to perform a behavior (Werner 2004).

This study explores links between consumers' attitudes about the healthfulness of various nonalcoholic beverages and their consumption of those beverages. We selected beverages based on nutritional components—calories, sugar, and fat—and test three hypotheses: (i) consumers' beverage consumption is affected by their perceptions of the healthfulness of beverages they consume (own-beverage) and of the relative healthfulness of various beverages (cross-beverage); (ii) consumers will drink more of beverages perceived as healthy; (iii) consumers will drink less of beverages perceived as less healthy. In addition, we consider socioeconomic characteristics and respondents' health conditions, lifestyles, and knowledge as potentially important factors that influence beverage consumption. The study results contribute to greater understanding of consumers' perceptions regarding the healthfulness of beverages and provide insight about consumer beverage choices.

Survey Design

The data set for this study was collected through a self-administered online survey through a national panel (hosted by Toluna) in March 2011. Online surveys hosted by panel companies have become more popular due to their low cost of administration and their ability to reach a significant percentage of the U.S. population. In 2013, 85 percent of adults age eighteen and older had access to the internet (Zickuhr 2013). In addition, more than one-third of U.S. households (35.8 percent) now rely completely on wireless phones (Blumberg and Luke 2012), which typically are not included in telephone sample frames. While telephone surveys usually must rely on generic directory information, online panels can be tailored using various recruitment methods to generate a targeted sample population representing specific demographic characteristics. In our case, panelists were recruited by Toluna via web banners, public relations, website referrals, and other methods. The panelists were validated using *GeoIP* and postal codes, double opt-in procedures, and internet cookies to prevent duplication and had to be eighteen years of age or older. In addition to Toluna's panel quality-control measures, we included a validation or "trap" question in the survey to ensure that panelists were reading the questions carefully (respondents were asked to respond to a particular question with a specific answer; those who did not were excluded from the survey). One drawback of using an internet panel is the volunteer nature of recruiting panelists; there is no basis by which to calculate sampling error. Instead, a completion rate is typically calculated based on the number of participants who complete the first question of the survey compared to the number who finish the entire survey. The survey was designed to identify consumers' patterns of consumption of nonalcoholic beverages, nutrition knowledge, health conditions, use of nutrition labels, general perceptions of the healthfulness of various beverages, and demographic characteristics.

To determine beverage consumption habits, we asked respondents to report the quantity and frequency of their consumption of thirteen beverages (Figure 1, left side). Frequency was reported as daily, weekly, or infrequently. Participants who consumed a beverage daily or weekly were asked to indicate the number of times the beverage was consumed (1–7) and the type of container and its volume.[1] The volume measurement options are described in Figure 1. We then calculated each participant's daily beverage intake. For example, if a participant drank three cups of water per day, daily water consumption was 24 fluid ounces (3 cups × 8 fluid ounces per cup).

After answering the questions about their beverage consumption, participants were asked to rate how healthy[2] they believed each of the thirteen beverages to be (Figure 1, right side). We selected the beverages to represent nonalcoholic ready-to-drink products typically found in a grocery store and offering a variety

[1] Actual question for those who indicated that they drank a particular beverage daily: "Please indicate how much you drink of the following beverages on average on a daily basis. For example, if you normally drink one canned soft drink per day, you will select 'can' from the measure column and '1' from the quantity." Those who indicated that they drank a particular beverage weekly were given the same question with "daily" replaced by "weekly."

[2] Actual question phrasing: "Let's assume you have one eight-ounce serving (one regular cup) of a beverage. Based only on the information given, please rate how HEALTHY you believe each beverage is."

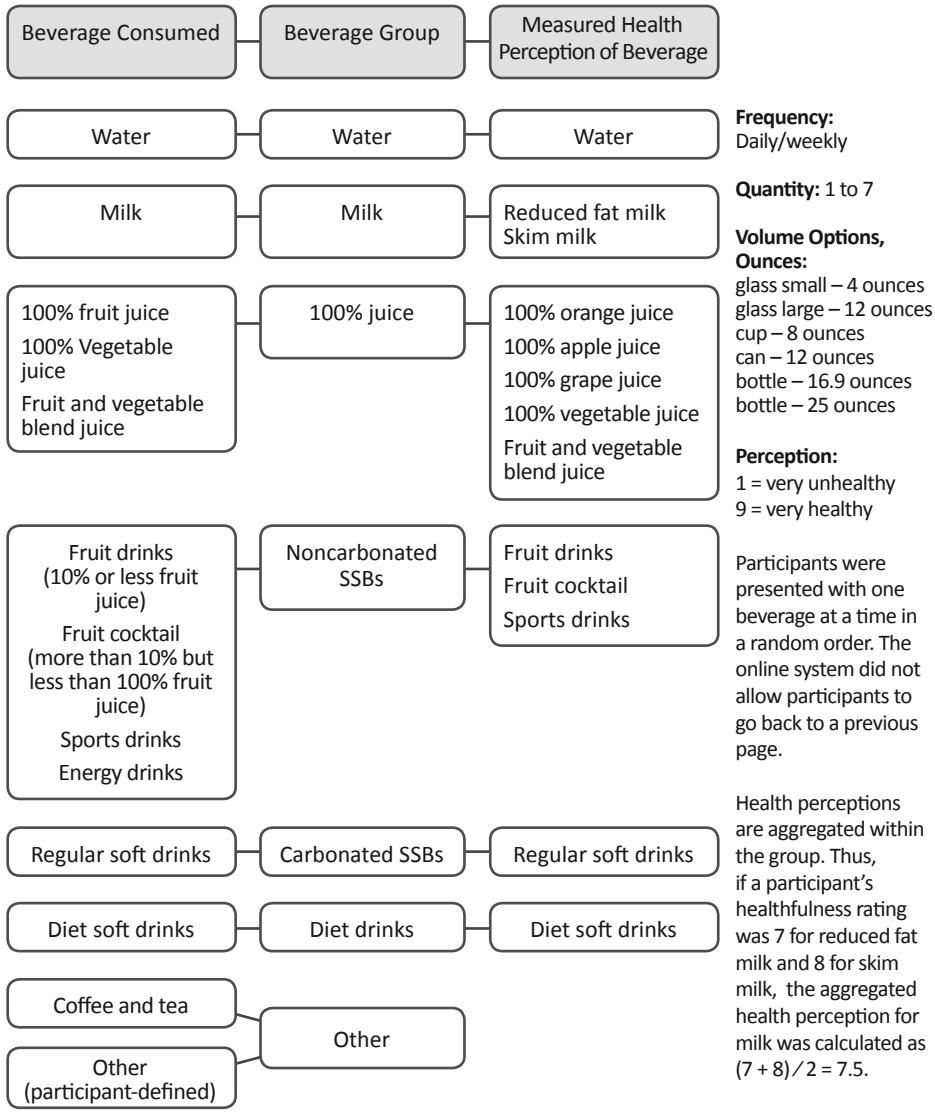

Figure 1. Reported Beverage Consumption, Measured Health Perceptions, and Their Groupings

of nutrients such as calories, sugar, fat, and vitamins and minerals.[3] Participants rated how healthy they thought each beverage was using a nine-point Likert scale in which 1 was "very unhealthy" and 9 was "very healthy." The survey was designed so that the beverages were presented to each participant one at a time and in a randomly generated sequence. The system did not allow participants to return to a previously viewed beverage.

Since our goal was to examine links between participants' beliefs about the healthfulness of the beverages and their consumption habits, we considered other variables that might impact their decisions. Previous studies have

[3] We excluded coffee and tea because they often are not purchased as ready-to-drink and because the amount of sugar and/or cream can vary significantly since individuals can add sugar and cream to ready-to-drink versions. Approximately 65 percent of coffee drinkers add cream and/or sugar (LiveScience 2011).

shown that beverage consumption is significantly related to socioeconomic characteristics (Zoellner et al. 2012, Bruijn and Putte 2009) so we included five demographic variables: age, education, gender, income, and race/ethnicity. We also incorporated variables representing each respondent's knowledge of the nutritional value of beverages and current health condition.

Since there may be differences between what consumers know and what they believe with regards to nutrition, we measured two knowledge variables: subjective knowledge and objective knowledge. Subjective knowledge was assessed by having respondents indicate the degree to which they agreed with the following statement using a seven-point Likert scale (with 1 as strongly disagree and 7 as strongly agree): I believe that I have good knowledge about the nutrition in beverages I usually drink. To measure respondents' objective knowledge, we focused on the sugar content of beverages. Participants were asked whether specific beverages contained no sugar, natural sugar, added sugar (including high fructose corn syrup), or artificial sweetener (such as Splenda® or Aspartame). Participants were later asked whether the same beverages were healthful.

The health of the participants was considered since beverage consumption may directly relate to health conditions such as diabetes. Two variables were included for diabetes: the first represented prediabetes (when participants indicated that they had been diagnosed as prediabetic or at risk of developing diabetes) and the second represented diabetes (when participants indicated that they were currently taking diabetes medication or insulin). To gather data about respondents' general lifestyles, the survey asked about their attitudes toward efforts to lose weight, nutrition information on food labels, and quality of food intake.

Data Description

The survey generated data from 1,535 respondents who provided their beverage consumption habits for all of the beverages studied. Definitions of the variables and brief descriptions of the respondents' characteristics are shown in Table 1. Averages for adults from the 2010 U.S. census are provided for comparison. Even though respondents in the sample were slightly weighted toward older, educated, female, and Caucasian characteristics, the sample was generally representative of the characteristics of the population nationwide. Approximately 41 percent of respondents were middle-aged adults (40–60 years old). Previous research (Storey, Forshee, and Anderson 2006, Popkin 2010) has shown that people significantly change their beverage consumption habits in middle-age (e.g., increased consumption of diet soft drinks).

On the subjective measure, respondents on average indicated that they had at least somewhat good knowledge about the nutrition provided in beverages they drink with an average score of 5.1 (on a scale of 1–7). Average objective knowledge about sugar in beverages was 0.8 (on a scale of 0.0–1.0). These results indicate that the average consumer has fairly good knowledge about nutrition and the sugar content of beverages. However, there were gaps between what they knew and what they believed; the correlation between objective and subjective knowledge was positive but weak with a correlation coefficient of 0.15.

Eighteen percent of the respondents indicated that they had been diagnosed as prediabetic or at risk of developing diabetes by a doctor and approximately

Table 1. Sample Descriptive Statistics and Variable Descriptions

Variable Description and Code Code for dummy variables is zero otherwise	**Sample** (N = 1,535) (percent)	**U.S. Census** (percent)
Gender		*Age 18+*
= 1 if male	41.8	48.5
Age		*Age 20+*
= 1 if younger than 40	28.9	36.7
= 2 if 40–60	40.7	37.9
= 3 if 61+	30.4	25.3
Household Income		
= 1 if under $25,000	22.1	25.7
= 2 if $25,000 to $49,999	34.2	24.7
= 3 if $50,000 to $74,999	21.4	17.7
= 4 if $75,000 or more	22.2	31.9
Education		
= 1 if less than high school	1.7	12.9
= 2 if high school (four years) and some college	61.6	57.2
= 3 if college four years or more	36.7	29.9
Race		
= 1 if Caucasian	86.0	79.6
Prediabetes[a,b]		
= 1 if diabetes, prediabetes, or risk for diabetes	17.5	25.6
Diabetes[b]		
= 1 if taking diabetes medication or insulin	9.6	8.3
Diet		
= 1 if effort to lose weight	53.0	—
Attitude about Reading Nutrition Fact Panels		
= 1 if respondents consider reading nutrition fact panels time-consuming	21.5	—
Self-evaluation of Eating Habits		
= 1 if respondents consider their eating and drinking habits as poor	5.3	—
Subjective Knowledge		
Average rate: agreement about nutritional knowledge for beverages usually drunk (1 strongly disagree – 7 strongly agree)	5.1	—
Objective Knowledge		
Average score: respondents' correct answers about sugar content in beverages (0.0–1.0)	0.8	—
Resident of Obesity State *(calculated using resident population by age (18 or older) and state)*		
= 1 if respondents live in state with obesity rate of less than 25.0 percent	31.3	45.2
= 2 if respondents live in state with obesity rate of 25.0–29.9 percent	39.4	25.3
= 3 if respondents live in state with obesity rate of 30.0 percent or higher	29.4	29.5
Daily		
= 1 if respondents drink the beverage daily		—

[a] Approximately 18 percent of respondents indicated that they were at risk for diabetes. In the analysis, we selected only respondents who did not take diabetes medication or insulin (7.9 percent) for comparisons of the effect of different diabetes risk levels on beverage consumption share.

[b] CDC (2011): 25.6 million people who are 20 years or older have diabetes and 79 million people 20 years or older have prediabetes. We divided the number of people into the U.S. population in 2010 (308.7 million).

ten percent of respondents indicated that they were taking insulin or diabetes medication. Those who indicated that they were at risk or prediabetic but were not taking medicine were placed in one group and those taking medication were placed in a second group (considered to be at higher risk). Using statistics on diabetes from the Centers for Disease Control and Prevention (CDC) (2011), we found that 25.6 percent of the U.S. population is prediabetic and 8.3 percent had diabetes in 2010. The percentage of people taking medication for diabetes is similar to our sample while the percentage of the population that is prediabetic is higher than in our sample. This may be a result of underreporting in our sample or of a number of survey respondents not being aware of being prediabetic.

Other factors potentially related to beverage consumption include concern about weight and current habits related to consumption. More than half of all respondents in our survey indicated that they had actively tried to lose weight during the preceding year. Nearly all respondents (95 percent) indicated that their eating and drinking habits were good. By comparison, the 2013 Food and Health Survey by the International Food Information Council Foundation asked participants to grade their diets in terms of healthfulness using letter and plus/minus grades (Schmidt 2013). The average grade was B– and 95 percent of the participants indicated that their diets were at least fair or satisfactory in terms of healthfulness (i.e., above C–). Also, 80 percent agreed that reading nutrition fact panels on food labels was not time consuming.

To consider the links between consumers' perceptions of the healthfulness of beverages and beverage consumption, we grouped the thirteen beverages into seven categories—water, milk, 100 percent juice, noncarbonated SSBs, carbonated SSBs, diet drinks, and other (see Figure 1)—based on caloric content, sugar content, nutritional composition, and attributes such as carbonation.[4] We distinguished between noncarbonated and carbonated SSBs because of the importance of regular soft drinks in total U.S. beverage consumption (Storey, Forshee, and Anderson 2006) and their potential significance related to health problems (Vartanian, Schwartz, and Brownell 2007). Since our focus was on nutrition components in beverages that typically can be purchased as ready-to-drink from grocery stores, we assigned coffee and tea to the "other" category. For each group, we aggregated the data on consumption and averaged the responses regarding the healthfulness of the associated beverages. For example, daily consumption of noncarbonated SSBs was calculated by summing daily consumption of fruit drinks, fruit cocktails, sports drinks, and energy drinks. The perception of the healthfulness of the noncarbonated SSB group was calculated by averaging responses for sports drinks, energy drinks, fruit drinks, and fruit juice cocktails.

Average total daily beverage consumption and each beverage's share of that consumption plus average perceptions of the healthfulness for each beverage are presented in Table 2. As a reference, we also present beverage consumption data from the National Health and Nutrition Examination Survey (NHANES) by the CDC for 2007/08 in Table 2.

On average, respondents in our sample drank 35.5 fluid ounces of water per day, which is comparable to the NHANES data showing 4.3 cups (about 34.4

[4] Factor analysis was conducted to see what health perceptions of beverages are highly related. Two factors were indicated as high loadings for two types of milk (reduced fat and skim milk) and five 100-percent juices (orange, apple, grape, vegetable, and fruit/vegetable blend). This implies that health perceptions of the beverage groups are similar.

Table 2. Respondents' Average Consumption, Consumption Share, and Health Perception of Various Beverages

Beverages	Daily Consumption in Fluid Ounces	Consumption Share	Health Perception	NHANES 2007/08
Water	35.45 (26.86)	0.44 (0.25)	8.59 (1.04)	Men: 4.4 cups Women: 4.2 cups
Milk	7.16 (9.60)	0.09 (0.11)	7.08 (1.38)	Men: 0.5 cups Women: 0.4 cups
100 percent juice	6.09 (11.67)	0.07 (0.10)	7.64 (1.25)	Men: 0.4 cups Women: 0.3 cups
Noncarbonated SSBs	3.48 (8.95)	0.04 (0.07)	4.59 (1.53)	—
Carbonated SSBs	5.70 (12.90)	0.07 (0.14)	2.27 (1.58)	Men: 1.9 cups Women: 1.1 cups
Diet drinks	5.53 (12.78)	0.07 (0.15)	3.18 (1.87)	Men: 0.7 cups Women: 0.8 cups
Other	17.73 (18.20)	0.23 (0.21)	—	—

Notes: Numbers inside parentheses are standard deviations. NHANES source: *Beverage Choices of U.S. Adults, What We Eat in America*, NHANES 2007/08. Beverage groups in our study are different: Water consumption is plain water. Milk consumption includes milk and milk drinks. 100 percent juice consumption includes all 100 percent fruit and vegetable juices. Consumption of carbonated SSBs and diet drinks distinguishes between calorically sweetened and noncalorically sweetened soft drinks, fruit drinks, sports drinks, and energy drinks.

fluid ounces) per day. Also, on average, respondents drank less than one cup of milk per day, which accounted for an average of 9 percent of respondents' total beverage consumption, slightly higher than the share reported in the NHANES. On average, respondents drank three-quarters of a cup of 100 percent juice per day. SSBs, on average, accounted for 11 percent (about 9.2 fluid ounces) of total daily beverage consumption, and carbonated SSBs (i.e., regular soft drinks) accounted for more than 60 percent (5.7 fluid ounces) of total SSB consumption. In the NHANES, men consumed 15.2 ounces (1.9 cups) and women consumed 8.8 ounces (1.1 cups) of caloric sweetened beverages. The relatively small share of consumption of SSBs in our sample may be related to its slightly larger proportion of middle-aged and older adults and women. Consumption of diet drinks in our sample was comparable to consumption of carbonated SSBs (7 percent). A majority of the consumption in the category of "other" was coffee and tea. Adults drank 18 fluid ounces of other types of beverages daily, which represents 23 percent of the average total beverage consumption per day.

Consumers perceived water as the healthiest drink; its average rating in terms of healthfulness was 8.6 (on a scale of 1.0–9.0), followed by 100 percent juice (7.6) and milk (7.1). The average health ratings for carbonated SSBs, diet drinks, and noncarbonated SSBs were 2.3, 3.2, and 4.6, respectively (these ratings indicate that these beverages were perceived as unhealthy). At a glance, the results suggest that people base how much of a particular beverage they consume in part on their perceptions of its relative healthfulness, but it is

difficult to define the general relationship for any of the beverages except water and milk. Further analysis was conducted to examine this relationship.

Model Specification

To determine the relationship between beverage consumption and perceptions about the healthfulness of those beverages, we specified a model in which beverage consumption share is the dependent variable. The underlying response model is

$$Y_i = \alpha_i + \sum_{j=1}^{N} \beta_{ij} H_j + \sum_{k=1}^{K} \gamma_{ik} X_k + \varepsilon_i, \qquad i, j = 1, \ldots, N$$

where Y_i is beverage i's share of total daily beverage consumption, H_j represents the perception of healthfulness for beverage j, X_k is a linear index of demographic characteristics, knowledge, diabetic condition, and lifestyle, and ε_i represents unobservable characteristics. The estimated parameters β_{ij} and γ_{ik} are partial effects of corresponding covariates that control for other variables in the model. Thus, the estimated parameter β_{ij} indicates the change in beverage consumption share as the health perception of the suite of beverages changes. If $i = j$, there is an own-beverage health perception effect. Otherwise, there is a cross-beverage health perception effect.

Seemingly unrelated regression was used to solve the model since an individual's consumption of one beverage was related to that person's consumption of beverages in the other six categories (see Figure 1). We excluded the share of "other" beverages to avoid singularity since the sum of the shares of the seven beverage groups is one.

Estimated Results

Before running the model, we checked for the presence of multicollinearity due to the possibility of collinearity among covariates. The mean of the variance inflation factor was 1.19 and no variables obtained a score greater than 2.0. Variance inflation factor scores greater than 10.0 indicate harmful collinearity (O'Brien 2007); hence, multicollinearity is not a problem in our data set. We present the results from the regression estimation in Table 3. The R-squares indicate that the model explained the total variation in beverage consumption share to a moderate degree. The Breusch-Pagan statistic (Breusch and Pagan 1980) of independence of residuals was 79.58, which was rejected at the 5 percent level, indicating that the equations were related by their error terms. This result supports the use of system equations. To compare the sensitivity of beverage consumption share to changes in perceptions about beverages' healthfulness, we derived elasticities at the mean of beverage consumption share and health perception. They are shown in Table 4. Standard errors were calculated based on the delta method.

Effect of Beverage Health Perception

Our results indicate that own-beverage health perceptions are significant and positively linked to beverage consumption share (Table 3). Since the dependent variable is share of consumption, the estimated parameters directly indicate the effect on the percent point of beverage consumption share when beverage

Table 3. Estimated Results of Seemingly Unrelated Regression

	Beverage Consumption Share Model					
Covariate	**Water**	**Milk**	**100% Juice**	**Noncarb. SSBs**	**Carb. SSBs**	**Diet Drinks**
Intercept	0.316**	0.083**	0.088**	0.070**	0.049	0.006
	(0.080)	(0.034)	(0.030)	(0.026)	(0.036)	(0.038)
Health Perception						
Water	0.021**	–0.004*	–0.002	–0.004**	–0.003	–0.003
	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Milk	–0.004	0.005**	–0.002	0.001	–0.002	0.002
	(0.004)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
100 percent juice	–0.018**	–0.001	0.005**	0.000	0.004*	–0.004*
	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Noncarbonated SSBs	–0.011**	–0.001	0.002	0.006**	0.002	–0.002
	(0.004)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Carbonated SSBs	–0.006	0.000	0.003**	0.001	0.004**	–0.001
	(0.004)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Diet drinks	–0.004	–0.003**	–0.003**	–0.001	–0.001	0.006**
	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Age	–0.022**	–0.004	–0.012**	–0.019**	–0.009**	0.005
	(0.007)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Gender	–0.040**	0.007	–0.004	0.011**	–0.001	0.000
	(0.011)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
Education	–0.005	–0.002	0.006	0.004	0.004	–0.005
	(0.011)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
Income	0.000	–0.006**	–0.001	0.001	–0.005**	0.000
	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Race	–0.079**	0.008	–0.019**	–0.001	0.006	0.005
	(0.015)	(0.007)	(0.006)	(0.005)	(0.007)	(0.007)
Resident of obesity state	–0.010	0.000	0.004	–0.003	0.000	0.000
	(0.007)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Subjective knowledge	0.007*	–0.003	–0.002	–0.001	–0.012**	–0.004**
	(0.004)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Objective knowledge	0.011	0.008	–0.036	–0.025	0.057**	0.093**
	(0.060)	(0.026)	(0.023)	(0.020)	(0.028)	(0.029)
Prediabetes	0.003	–0.012	–0.008	–0.003	0.001	0.011
	(0.019)	(0.008)	(0.007)	(0.006)	(0.009)	(0.009)
Diabetes	–0.031*	0.016**	0.021**	–0.005	–0.022**	0.006
	(0.018)	(0.008)	(0.007)	(0.006)	(0.008)	(0.009)
Diet	–0.008	–0.002	–0.001	0.004	–0.005	–0.003
	(0.011)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
Attitudes about reading nutrition fact panels	–0.011	–0.003	–0.005	0.001	0.012**	0.002
	(0.013)	(0.005)	(0.005)	(0.004)	(0.006)	(0.006)
Self-evaluation of eating habits	–0.014	–0.013	0.002	0.006	0.065**	–0.005
	(0.024)	(0.010)	(0.009)	(0.008)	(0.011)	(0.011)
Daily consumption	0.362**	0.135**	0.128**	0.082**	0.270**	0.297**
	(0.016)	(0.004)	(0.004)	(0.005)	(0.007)	(0.007)
R-square	0.379	0.412	0.403	0.228	0.601	0.615
System-weighted R-square	0.466					
Breusch-Pagan test	79.577**					

Notes: Numbers inside the parentheses are standard errors. * and ** indicate that the t-test results are significant at a 10 percent and 5 percent level, respectively.

health perception changes by one unit. For example, when consumer health perception for water increases by one unit, share of water consumption increases by 2.1 percentage points. The link between perceptions of a beverage's healthfulness and consumption of that beverage is further demonstrated by the results provided in Table 4; the diagonal elements, which show elasticities of beverage consumption share for own-health perceptions, are all positive. Consumers who perceive a beverage as healthy tend to drink a larger share of that beverage relative to other beverages. The elasticities allow for easier cross-category comparisons by examining the percent change in consumption share given a 1 percent change in perception. All of the own-beverage elasticities are inelastic. Consumption of noncarbonated SSBs is the most sensitive to changes in perception with a 0.79 percent increase in share given a 1.0 percent increase in perception of healthfulness and is followed by 100 percent juice (0.52 percent) and water (0.40 percent). Carbonated SSB share is the least sensitive to changes in health perception (0.14 percent). These results suggest that providing information that leads consumers to see SSBs as less healthy will be effective; the effect will be greater for noncarbonated SSBs than for carbonated SSBs.

The results for cross-beverage health perceptions varied, though consumption shares generally were more sensitive to own-beverage changes than to cross-beverage changes. Most of the significant effects of cross-beverage health perceptions have negative signs, indicating that people tend to consume proportionally less of a beverage when they perceive other beverages as more healthy. For example, consumers who perceive water as

Table 4. Elasticities of Consumption Share for Beverage Health Perception at the Mean of Beverage Consumption Share and Health Perception

	Beverage Consumption Share Model					
Health Perception	**Water**	**Milk**	**100% Juice**	**Noncarb. SSBs**	**Carb. SSBs**	**Diet Drinks**
Water	0.404** (0.103)	–0.425* (0.218)	–0.282 (0.244)	–0.849** (0.400)	–0.379 (0.296)	–0.429 (0.315)
Milk	–0.062 (0.067)	0.391** (0.144)	–0.205 (0.160)	0.251 (0.262)	–0.182 (0.194)	0.170 (0.206)
100 percent juice	–0.323** (0.083)	–0.09 (0.175)	0.519** (0.198)	0.088 (0.322)	0.444* (0.240)	–0.469* (0.253)
Noncarbonated SSBs	–0.119** (0.043)	–0.072 (0.091)	0.134 (0.102)	0.792** (0.167)	0.108 (0.124)	–0.146 (0.131)
Carbonated SSBs	–0.030 (0.020)	0.003 (0.042)	0.112** (0.047)	0.053 (0.077)	0.143** (0.057)	–0.048 (0.061)
Diet drinks	–0.031 (0.023)	–0.123** (0.048)	–0.154** (0.054)	–0.046 (0.089)	–0.052 (0.066)	0.276** (0.072)

Notes: * and ** indicate that the test results are significant at a 10 percent and 5 percent level, respectively. Numbers inside parentheses are standard errors calculated based on the delta method.

healthy drink a smaller share of milk and noncarbonated SSBs, but consumers' perceptions about the healthfulness of water have no impact on consumption share of 100 percent juice, carbonated SSBs, and diet drinks. Perceptions of 100 percent juice as healthy negatively influence the consumption share of water and diet drinks, and perceptions of noncarbonated SSBs as healthy also negatively relate to the consumption share of water. Consumers who viewed diet drinks as healthy had a smaller consumption share of milk and 100 percent juice.

One link was surprising. As consumers' perceptions of the healthfulness of 100 percent juice increased, so did their consumption of carbonated SSBs as a share of their total beverage consumption and vice versa. Furthermore, the effect of health perception for 100 percent juice on consumption of carbonated SSBs was greater than the effect of health perception of carbonated SSBs on juice consumption (Table 4). A 1 percent increase in perception of the healthfulness of 100 percent juice increased the share of consumption of carbonated SSBs by 0.44 percent while a 1 percent increase in health perception of carbonated SSBs only increased the share of consumption of 100 percent juice 0.11 percent. There may be consumers who do not differentiate between added and naturally occurring sugar in drinks. In that case, if they perceive 100 percent juice as healthy, their share of beverages for drinks with added sugar (carbonated SSBs) will also increase.

We find that the effect of consumers' perceptions of the healthfulness of various beverages is not always symmetric. While a perception that diet drinks are healthy negatively influences the share of milk, a perception that milk is healthy does not negatively link to the share of diet drinks. This asymmetry occurs in some of the cases of positive cross-effects.

Effect of Nutritional Knowledge and Health Condition

The effect of consumers' knowledge about beverage nutrition on beverage consumption share varies across beverage types. Subjective knowledge is positively linked to water consumption share but negatively linked to carbonated SSBs and diet drinks. That is, consumers who evaluated their knowledge of the nutritional value of various beverages as high drank a larger share of water and a smaller share of carbonated SSBs and diet drinks. Consumers who obtained higher objective knowledge scores about sugar in beverages drank a larger share of carbonated SSBs and diet drinks. These results imply that consumers' tendency to drink carbonated SSBs is not related to lack of information about potential health risks associated with sugar. Approximately 77 percent of consumers were aware that regular soft drinks contain added sugar and 89 percent were aware that diet soft drinks contain artificial sweeteners. Men consume approximately 1.9 cups of caloric sweetened beverages per day and women consume approximately 1.1 cups (Table 2), and those beverages account for approximately 45 percent of the added sugar consumed daily (U.S. Departments of Agriculture and Health and Human Services 2010). Thus, providing information that focuses on the sugar content of SSBs is unlikely to be effective in changing behavior. However, since consumers who rated their overall knowledge of nutrition as high drank less SSBs, providing information on nutrients other than sugar could be effective.

As expected, consumers' consumption of various beverages depended on the seriousness of their diabetes condition. There was no significant difference

in beverage consumption between consumers who were not diabetic and consumers who indicated that they were at risk for diabetes but were not taking insulin or medication. In contrast, consumers who were taking diabetes medication or on insulin drank a smaller share of water and carbonated SSBs and a larger share of milk and 100 percent juice. Consumers who were taking medication for diabetes tended to drink a larger share of more nutritious beverages and a smaller share of sugary beverages.

Effect of Socioeconomics and Lifestyles

Our results demonstrate links between socioeconomic characteristics and beverage consumption patterns across beverage types. Older consumers drank less water, 100 percent juice, noncarbonated SSBs, and carbonated SSBs, a finding that is consistent with Storey, Forshee, and Anderson (2006). Men were less likely to drink water and more likely to drink noncarbonated SSBs than women. Storey, Forshee, and Anderson (2006) found that men had higher energy intake from beverages than women. Our findings imply that men may get more of their daily energy (calories) from noncarbonated SSBs such as fruit drinks, sports drinks, and energy drinks than women do since their beverage share for those products was higher. Respondents' education levels did not significantly relate to beverage consumption share. Interestingly, respondents with higher incomes drank smaller shares of milk and carbonated SSBs. Davis et al. (2012) found positive expenditure elasticities for fluid milk that indicated that it is a normal good—fluid milk consumption increases with increases in income. We conducted an analysis of variance to verify any significant differences in milk consumption and share of milk consumption by income level. The F-statistics failed to reject the hypothesis of equal average milk consumption by income level while the hypothesis that average milk consumption share by income level is equal was rejected at the 5 percent significance level. Overall, we thus infer that milk is a normal good but that the share of total beverages consumed devoted to milk varies with income. Among racial/ethnic groups, Caucasians drank the smallest share of water and 100 percent juice, a result consistent with Storey, Forshee, and Anderson (2006). The variable representing whether the respondent lived in a state that had a high rate of obesity did not significantly explain beverage consumption patterns.

Consumer attitudes related to nutrition and diet had a significant influence on beverage consumption patterns. Consumers who responded negatively to food labels (found reading them time-consuming) and who believed they had poor eating and drinking habits showed similar patterns of beverage consumption. They tended to drink larger shares of carbonated SSBs and thus seemed to be aware of the implications of their choices. Consumers who reported actively trying to lose weight were not significantly less likely to drink SSBs. The shares of consumption of SSBs and diet drinks were approximately 30 percent greater for respondents who consumed the drinks daily than for those who consumed them weekly. This may indicate that habit is an important factor in explaining beverage consumption patterns.

Implications and Conclusion

A number of studies have linked consumption of caloric beverages with obesity in the United States, but few have focused on the effect of consumers'

perceptions about the healthfulness of various beverages on consumption of those drinks. Human behavior is complex and influenced by many factors, but health perceptions are considered to be a key variable associated with consumers' decisions related to purchasing and consuming foods and drinks.

This study focuses on the importance of psychometric properties in beverage consumption decisions, including how consumers' perceptions of the relative healthfulness of various beverages impact their consumption of those beverages. We show that such perceptions at least partially explain participants' beverage drinking behavior. Beverage consumption was influenced by both own-beverage and cross-beverage perceptions with the consumption share increasing as perceptions of a beverage's healthfulness rose. In most cases, as perception of the healthfulness of a beverage increased, the share of consumption of other beverages decreased or did not change. Most of the significant cross-beverage health perceptions were negatively related but there were some exceptions. In particular, consumers who perceived 100 percent juice as healthy drank more carbonated SSBs and vice versa. Nutritionists, health practitioners, and researchers continue to debate whether 100 percent fruit juice should be considered a sugary drink. Our results indicate that consumers' perceptions of beverages containing sugar are positively related to consumption of carbonated SSBs. This might indicate that consumers do not pay very much attention to nutrition content and thus do not differentiate much between various types of drinks that contain sugar regardless of their relative nutritional value. Additional research is required to clearly describe that relationship. In addition, the specific nature of each type of beverage and consumer preferences may result in asymmetric cross-effects of health perceptions. That is, the purpose of drinking a beverage may vary from one consumer to another because each beverage offers a unique combination of taste, calories, and nutrition.

U.S. policymakers have considered many different approaches in their efforts to reduce the incidence of obesity. One has been provision of nutrition information labeling on the front of food packages to help consumers make healthier choices. A number of studies have demonstrated a link between obesity and consumption of SSBs. Although consumption of SSBs decreases as consumers age, the quantity consumed by young adults and adults remains significant. Kim et al. (2012) found that displaying nutrition information on the front of food packages reduced the gap in perceptions of the healthfulness of 100 percent fruit juice relative to regular soft drinks. Our findings support that study; respondents who viewed beverages containing sugar as healthy also consumed a relatively large share of carbonated SSBs. On average, respondents in our study perceived 100 percent juice as healthy and the individual respondents who held that belief drank a relatively larger share of carbonated SSBs. Carbonated SSBs and 100 percent juice contain comparable amounts of sugar and calories, but the two beverages are distinguishable in terms of the nutrition they provide via vitamins and minerals. In addition, we found that consumers who were relatively knowledgeable (objectively) about sugar in beverages drank larger shares of carbonated SSBs and diet drinks while consumers who self-rated (subjectively) their nutritional knowledge about beverages as high drank a smaller share of these beverages. To disconnect links between 100 percent juice and carbonated drinks, food labels may need to emphasize positive nutrition information rather than sugar content. Also, as we have shown, consumers tended to perceive carbonated and noncarbonated SSBs differently in terms of healthfulness, and the effect of those perceptions

on beverage consumption varied. Thus, sophisticated policy approaches will be required to effectively reduce consumption of carbonated SSBs.

Brownell et al. (2009) suggested imposing an excise tax on all beverages that have an added caloric sweetener as a way to reduce consumers' intake of calories from SSBs. Such a policy measure could be effective in educating consumers about the difference between 100-percent-juice beverages and SSBs, but it could also give the impression that beverages that contain noncaloric sweeteners are relatively healthful drinks.

This study focused on the nutritional content of ready-to-drink nonalcoholic beverages in grocery stores. Therefore, it omitted coffee and tea. Future studies could account for the importance of coffee and tea in total beverage consumption and include those drinks in the analysis. In addition, distinguishing between plain and sugar-sweetened coffee and tea would be useful.

References

Ajzen, I. 1991. "The Theory of Planned Behavior." *Organizational Behavior and Human Decision Processes* 50(2): 179–211.

Ajzen, I., and M. Fishbein. 1977. "Attitude-Behavior Relations: A Theoretical Analysis and Review of Empirical Research." *Psychological Bulletin* 84(3): 888–918.

Bargh, J.A. 2003. "Why We Thought We Could Prime Social Behavior." *Psychological Inquiry* 14(3/4): 216–218.

Blumberg, S.J., and J.V. Luke. 2012. *Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, January–June 2012*. Division of Health Interview Statistics, National Center for Health Statistics, CDC, Atlanta, GA. Available at www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201212.pdf (accessed October 30, 2013).

Brannon, R. 1976. "Attitudes and the Prediction of Behavior." In B. Seidenberg and A. Snadowsky, eds., *Social Psychology: An Introduction*. New York: Free Press.

Breusch, T.S., and A. Pagan. 1980. "The Lagrange Multiplier Test and Its Applications to Model Specification in Econometrics." *Review of Economic Studies* 47(1): 239–253.

Brownell, K.D., T. Farley, W.C. Willett, B.M. Popkin, F.J. Chaloupka, J.W. Thompson, and D.S. Ludwig. 2009. "The Public Health and Economic Benefits of Taxing Sugar-sweetened Beverages." *New England Journal of Medicine* 361(16): 1599–1605.

Brucks, M. 1985. "The Effects of Product Class Knowledge on Information Search Behavior." *Journal of Consumer Research* 12(1): 1–16.

Bruijn, G., and B. Putte. 2009. "Adolescent Soft Drink Consumption, Television Viewing, and Habit Strength. Investigating Clustering Effects in the Theory of Planned Behavior." *Appetite* 53(1): 66–75.

Carels, R.A., K. Konrad, and J. Harper. 2007. "Individual Differences in Food Perceptions and Calorie Estimation: An Examination of Dieting Status, Weight, and Gender." *Appetite* 49(2): 450–458.

Centers for Disease Control and Prevention. 2011. *National Diabetes Fact Sheet: National Estimates and General Information on Diabetes and Prediabetes in the United States, 2011*. CDC, U.S. Department of Health and Human Services, Atlanta, GA.

———. 2008. "National Health and Nutrition Examination Survey" data. CDC, Atlanta, GA.

Chartrand, T.L., and J.A. Bargh. 1999. "The Chameleon Effect: The Perception-Behavior Link and Social Interaction." *Journal of Personality and Social Psychology* 76(6): 893–910.

Davis, C.G., D. Dong, D. Blayney, S.T. Yen, and R. Stillman. 2012. "U.S. Fluid Milk Demand: A Disaggregated Approach." *International Food and Agribusiness Management Review* 15(1): 25–50.

DiMeglio, D.P., and R.D. Mattes. 2000. "Liquid versus Solid Carbohydrates: Effects on Food Intake and Body Weight." *International Journal of Obesity and Related Metabolic Disorders* 24(6): 794–800.

House, L., J. Lusk, S. Jaeger, W. Traill, M. Moore, C. Valli, B. Morrow, and W. Yee. 2004. "Objective and Subjective Knowledge: Impacts on Consumer Demand for Genetically Modified Foods in the United States and the European Union." *AgBioForum* 7(3): 113–123.

Kim, H., L.A. House, G. Rampersaud, and Z. Gao. 2012. "Front-of-package Nutritional Labels and Consumer Beverage Perceptions." *Applied Economic Perspectives and Policy* 34(4): 599–614.

Kolodinsky, J., J.R. Harvey-Berino, L. Berlin, R.K. Johnson, and T.W. Reynolds. 2007. "Knowledge of Current Dietary Guidelines and Food Choice by College Students: Better Eaters Have Higher Knowledge of Dietary Guidance." *Journal of the American Dietary Association* 107(8): 1409–1413.

Liska, A.E. (ed.). 1975. *The Consistency Controversy: Readings on the Impact of Attitude on Behavior*. New York: Wiley.

LiveScience. 2011. "Coffee Facts for National Coffee Day" web page. www.livescience.com/16297-coffee-facts-national-coffee-day-infographic.html.

Mattes, R. 2006. "Fluid Calories and Energy Balance: The Good, the Bad, and the Uncertain." *Physiology and Behavior* 89(1): 66–70.

O'Brien, R.M. 2007. "A Caution regarding Rules of Thumb for Variance Inflation Factors." *Quality and Quantity* 41(5): 673–690.

Park, C.W., D.L. Mothersbaugh, and L. Feick. 1994. "Consumer Knowledge Assessment." *Journal of Consumer Research* 21(1): 71–82.

Pereira, M.A., and V.L. Fulgoni III. 2010. "Consumption of 100% Fruit Juice and Risk of Obesity and Metabolic Syndrome: Findings from the National Health and Nutrition Examination Survey 1999–2004." *Journal of the American College of Nutrition* 29(6): 625–629.

Popkin, B.M. 2010. "Patterns of Beverage Use across the Lifecycle." *Physiology and Behavior* 100(1): 4–9.

Ruddell, F. (ed.). 1979. *Consumer Food Selection and Nutrition Information*. New York: Praeger Publisher.

Schmidt, D. 2013. *Food and Health Survey, 2013*. International Food Information Council Foundation, Washington, DC. Available at http://conference.ifas.ufl.edu/citrus/presentations/Wednesday/PM/0335Schmidt.pdf (accessed October 30, 2013).

Schulze, M.B., J.E. Manson, D.S. Ludwig, G.A. Colditz, M.J. Stampfer, W.C. Willett, and F.B. Hu. 2004. "Sugar-sweetened Beverages, Weight Gain, and Incidence of Type 2 Diabetes in Young and Middle-aged Women." *The Journal of the American Medical Association* 292(2): 927–934.

Storey, M.L., R.A. Forshee, and P.A. Anderson. 2006. "Beverage Consumption in the U.S. Population." *Journal of the American Diet Association* 106(12): 1992–2000.

Tepper, B.J., Y-S. Choi, and R.M. Nayga. 1997. "Understanding Food Choice in Adult Men: Influence of Nutrition Knowledge, Food Beliefs, and Dietary Restraint." *Food Quality and Preference* 8(4): 307–317.

U.S. Departments of Agriculture and Health and Human Services. 2010. *Dietary Guidelines for Americans 2010*. USDA/DHHS, Washington, DC. Available at www.health.gov/dietaryguidelines/dga2010/DietaryGuidelines2010.pdf (accessed on October 30, 2013).

Vartanian, L.R., M.B. Schwartz, and K.D. Brownell. 2007. "Effects of Soft Drink Consumption on Nutrition and Health: A Systematic Review and Meta-Analysis." *American Journal of Public Health* 97(4): 667–675.

Werner, P. 2004. "Reasoned Action and Planned Behavior." In S.J. Peterson and T.S. Bredow, eds., *Middle Range Theories: Application to Nursing Research*. Philadelphia, PA: Lippincott Williams & Wilkins.

Wicker, A.W. 1969. "Attitudes versus Actions: The Relationship of Verbal and Overt Behavioral Responses to Attitude Objects." *Journal of Social Issues* 25(4): 41–78.

Zickuhr, K. 2013. *Who's Not Online and Why*. Pew Research Center's Internet and American Life Project. Washington, DC. Available at www.pewinternet.org/Reports/2013/Non-internet-users.aspx (accessed October 30, 2013).

Zoellner, J., P.A. Estabrooks, B.M. Davy, Y-C. Chen, and W. You. 2012. "Exploring the Theory of Planned Behavior to Explain Sugar-sweetened Beverage Consumption." *Journal of Nutrition Education and Behavior* 44(2): 172–177.