Nutritional Contributions of Nonalcoholic Beverages to the U.S. Diet: 1998-2003

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Introduction

Obesity among all walks of life is one of the most urgent and widely emphasized nutrition-related health problems in America today. According to the publication, "A Handbook on Obesity in America", by the Endocrine Society and the Hormone Foundation (2005), 127 million adults in the U.S. are overweight (BMI[1] 25-29.9), 60 million are obese (BMI 30-39.9) and 9 million are extremely obese (BMI 40 or greater than 40). Nayga (2008) reported that recent obesity rates for men and women in the United States are 36.5% and 41.8% respectively.

The overweight/obesity problem is not only an issue with adults but also with children and adolescents. The Centers for Disease Control and Prevention (2007) of U.S. Department of Health and Human Services, reports that from 1980 through 2004 the prevalence of the overweight issue is increasing among children and adolescents in America. The percentage of children aged 2-5 years classified as overweight increased from 5% to 13.9% from 1980 to 2004, and the percentage of children aged 6-11 years classified as overweight rose from 6.5% to 18.8%. The percentage of adolescents (12-19 years) classified as overweight also increased from 5% to 17.4% for adolescents over this time period.

In addition to environmental and genetic factors, the selection of food and beverages is a contributing factor to the condition of obesity. With the publication of the 2000 and 2005 USDA Dietary Guidelines for Americans, the role of beverages in the American diet increased in attention. There is a very wide variation in beverages in terms of their energy (caloric) content and nutrient composition, ranging from zero-calorie

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[1] BMI is the Body Mass Index. It is calculated as a ratio between a person's height (in meters) and weight (in kilograms). The exact formula is as follows, BMI=weight(kilograms)/height (meters squared) or BMI=weight(pounds)/height(inches squared)*703

bottled water to low-calorie diet soft drinks to heavily-caloric coffee drinks. Therefore, excessive consumption of beverages is not necessarily a good dietary choice due to extra calories they can contribute toward the daily recommended calorie requirement designed through a food guide pyramid published by USDA (2000[2] calories per day is a healthy daily requirement). Therefore, the beverage choice that individuals make have a potentially important influence on the quality of the diet, and more importantly on the risk of being obese and overweight.

The 2000 Dietary Guidelines gave prominence to the role of soft drinks and other sweetened beverages on the U.S. obesity problem. The 2005 Guidelines reiterated the need to limit calories from soft drinks. It emphasized even more strongly than previously the need to increase consumption of non-fat and/or low-fat milk in lieu of carbonated soft drinks (Dietary Guidelines for Americans, 2005).

Consumption of nonalcoholic beverages (NAB) also contributes various kinds of nutrients to the diet. Milk is a major source of calcium and vitamin D. According to the U.S. Department of Health and Human Services (2000), calcium and vitamin D are two nutrients that are of public concern. In an analysis of USDA food consumption survey data, Yen and Lin (2002) found that, for each 1-ounce reduction in milk consumption by a child, calcium intake was reduced by 34 milligrams. Juices are prepared from either fruits or vegetables and are good sources of vitamin C. Also, there are calcium-fortified fruit juices available today, such as orange juice. Vitamin C and calcium are two of the healthy nutrients that come from consumption of NAB. Caffeine is another ingredient found in most carbonated soft drinks, coffee, and tea. According to the American

[2] 2000 kilocalories per day is a daily recommended calorie intake for a healthy adult. This intake may vary depending on the calorie requirements individuals need due to special conditions they may have. For example, pregnant and lactating mothers require about 2300-2500 kilocalories per day.

Beverage Association (2007), beverage manufacturers have responded positively to the changing needs and interests of consumers by introducing many low-calorie, zero-calorie, calcium-fortified, and decaffeinated beverage choices.

Many U.S government programs targeting nutritional enhancement of households, such as the Food Stamp Program, National School Lunch Program, School Breakfast Program, and Special Supplemental Food Program for Women, Infants and Children (WIC), are in need of more current information pertaining to NAB consumption. Profiling of households is important to identify demographic populations potentially at risk in the consumption of NAB. For example, the WIC program provides vitamin C and calcium rich beverages such as fruit/vegetable juices and milk to its recipients. Eligibility for such programs are evaluated through a multitude of factors including a poverty threshold (calculated taking into account annual income of the household and household size). Government programs center attention on 100%, 130% or 185% of the poverty threshold.

Objectives

After the publication of aforementioned Dietary Guidelines, when consumers presumably are well-informed about the nutritional contribution of beverages to their diet, their consumption patterns of NAB ought to change. That is to say, one question of interest is whether or not the 2000 and 2005 USDA Dietary Guidelines for Americans have been effective in making changes in the intake of calories, calcium, caffeine and vitamin C derived from NAB.

In this light, specific objectives of this study are: (1) to determine the factors affecting calcium, caffeine, vitamin C and calories intake from the consumption of nonalcoholic beverages at-home for the period 1998 through 2003; and (2) to ascertain the impact of the 2000 USDA Dietary Guidelines for Americans in the intake of calcium, caffeine, vitamin C and calories from nonalcoholic beverages consumed at-home from 1998 through 2003.

Organization

This paper is organized as follows. We initially discuss the daily nutritional needs of an individual, and we review past studies done on nutritional contributions of nonalcoholic beverages to the U.S. diet. Subsequently, we present the methodology used to address the aforementioned objectives. We provide a description of the econometric analysis, and we give a detailed description of the data used in the study. Further, we provide the empirical results of the estimated econometric models, followed by relevant policy implications. Finally, we make concluding remarks and provide some limitations on the basis of our work.

Dietary Role of Nonalcoholic Beverages

Daily intake of calories, calcium and vitamin C can vary with gender, age and nutritional need of an individual. For example, active 2 to 3 year olds may require up to 1400 kilocalories per day regardless of their gender. An active male who is in the age category of 31-50 may require up to 3000 kilocalories per day. On average, calorie requirements are relatively lower for active females than active males by about 500 kilocalories per day. However, pregnant and lactating mothers need extra calories to sustain their special status (Center for Nutrition Policy Promotion, 2005). However, on the average, a normal healthy adult who does not have a special body condition requires about 2000 kilocalories per day.

Daily calcium requirement grows with the age. On average a healthy adult needs about 1000mg (one gram) of calcium per day (U.S. Department of Health and Human Services, (2004). Vitamin C also is a vital nutrient that is necessary in the daily diet. On average, an adult should get about 155mg of vitamin C per day to maintain a healthy body (Center for Nutrition Policy Promotion, 2005).

Unlike calcium and vitamin C, caffeine is an ingredient that should be consumed in moderation. According to the Surgeon General, excessive consumption of caffeine may interfere with calcium absorption (U.S. Department of Health and Human Services, 2004). Excess amounts of caffeine also may have deleterious effects on pregnancies, leading to miscarriages and impairment in the development of the nervous system.

We now turn attention to past studies done on contributions of nonalcoholic beverages to the U.S diet and related government policy actions. Harnack et al., (1999) studied nutritional consequences of soft drink consumption among U.S. children and adolescents. This study was limited to U.S. children aged 2 to 18 years during calendar years 1994 and 1995. The source of data for this analysis was the USDA Continuing Surveys of Food Intakes by Individuals (CSFII). Caloric intake was found to be positively related to soft drink consumption, while milk and fruit juice consumption was negatively associated with soft drink consumption.

According to Gortmaker et al. (1993), adolescent and young adulthood obesity/overweight problems not only contributed to health-related risks but also these problems have a deleterious effect on self-esteem and on educational attainment. They also found that adolescents were more likely to consume soft drinks than preschool- and school-aged children. White children consumed more soft drinks than black children, and boys consumed more soft drinks than girls. It was recommended that “dietetic professionals should inquire about soft drinks consumption when counseling children and ask parents to limit the amount of soft drinks brought into the home.

Gartner and Greer (2003) centered attention on the decline in milk consumption in America and the associated vitamin D deficiency among children. French et al. (2003) investigated the trends between 1977/78 and 1994/95 in the prevalence, amounts and sources of soft drink consumption among U.S. children and adolescents (6 to 17 years of age) using data from three national surveys. They found that the prevalence of the soft drink consumption increased by 48% over this time period. Mean intake of soft drinks more than doubled from 5 fl oz to 12 fl oz per day. Further, French et al, (2003) found that larger proportions of soft drinks were consumed at-home compared to vending machines, restaurants and school cafeteria.

Ahuja and Perloff (2001) examined the caffeine intake of U.S. children 9 years and under using data from USDA Continuing Survey of Food Intake by Individuals (CSFII) for the period 1994-96 and 1998. According to them, most widely consumed caffeine rich foods were coffee, tea, carbonated soft drinks and chocolate. It was found that more children actually obtained caffeine from consuming chocolate than from consuming carbonated soft drinks; 44% of children consumed chocolate in comparison to 20% who drank carbonated beverages containing caffeine. Furthermore, it was found that white children consumed more caffeine than the black children.

Chanmugam et al. (2003) studied fat and energy (calories) intake by U.S. households during the period 1989-1991 and 1994-1996 using CSFII data. They found that one of most important changes was the drop in whole milk consumption and an increase in the consumption of reduced-fat milk and carbonated soft drinks. Furthermore, they found that the higher caloric intake was due to excessive consumption of carbonated soft drinks. This research reinforced the findings of a similar study by Guthrie and Morton (2000). The latter was done to identify food sources of added sweeteners in the U.S. diet. Guthrie and Morton (2000) used 1994-1996 CSFII data in their investigation. They found that during the period 1994-1996 Americans aged 2 years and older obtained 16% of their total caloric intake from consumption of added sweeteners. One third of this intake came from consumption of regular soft drinks. Furthermore, Guthrie and Morton (2000) found that the percent contribution to added sweeteners intake from the consumption of soft drinks increased throughout the childhood and adolescence and peaked during the ages from 18 to 34 years for both men and women. The intake subsequently decreased steadily for older adults.

Capps et al. (2005) was the most comprehensive study done investigating the nutritional contribution of nonalcoholic beverages to the U.S. diet. The focus of their research was the nutrient availability from nonalcoholic beverages purchased for at-home consumption. Previous studies used data from the CSFII focusing on food and beverage intake based on individual recall over the two nonconsecutive days (within a 3-week period). Capps et al. (2005) used a scanner data set with demographics, namely the 1999 ACNielsen Homescan Panel. The focus was on household purchases over an entire year recorded by at-home scanning technology provided by ACNielsen. The Homescan Panel offered a potentially richer and more recent database for their study than the CSFII. According their findings, daily calorie intake derived from nonalcoholic beverages was mainly determined by employment status and education level attained by the household head as well as race, region and presence of children. Available calcium and vitamin C intake derived from nonalcoholic beverages was lower for poverty households compared to non-poverty households. Caffeine availability derived from nonalcoholic beverages was lower for blacks, Asians and other races compared to whites. Using the daily values of the Nutrition Facts portion of the food label as a reference, this study found that for calendar year 1999, nonalcoholic beverages purchased for at-home consumption provided 10% of daily value for calories, 20% of the daily value for calcium, and 70% of daily value for vitamin C, on per-person basis.

The aforementioned research by Capps et al., (2005) used scanner data with demographics attached for calendar year 1999 only. In this study, we use similar scanner data but for six calendar years: 1998, 1999, 2000, 2001, 2002 and 2003. With these data, we are able to consider patterns in nutrient intake derived from nonalcoholic beverage consumption over several years. In addition we are in a position to talk about the effectiveness of USDA dietary guidelines[3] on beverage consumption set forth in year 2000.

Methodology

Econometric models are developed and estimated using generalized least squares to capture the factors affecting the intakes of calcium, caffeine, vitamin C and calories through the consumption of NAB. Demographics, the price of NAB and poverty status of the household are hypothesized to affect the intake of each nutritional category. For each household, the price of nonalcoholic beverages is calculated as a weighted average price derived as the ratio between sum of annual expenditures and sum of annual quantities of

[3] USDA published dietary guidelines for Americans with special emphasis on the consumption of carbonated soft drinks in year 2000. In year 2005, the dietary guidelines placed more emphasis on milk consumption.

all nonalcoholic beverages. The demographics considered include age of household head, employment status of household head, education status of the household head, region, race, Hispanic origin, age and presence of children, gender of the household head(s) and poverty status of household. As well, we generate indicator variables corresponding to year to test for changes in intakes associated with each nutritional category between calendar years 1998, 1999 and 2000 (the reference period) and calendar years 2001, 2002, and 2003.

Poverty status is captured an indicator variable pertaining to 185% of the poverty threshold. Such a poverty measure is calculated by the United States Department of Health and Human Services, taking into account both income and household size.

Data Description

The source of the data for this analysis is the ACNielsen Homescan panel data for calendar years 1998 through 2003. These data are taken from a sample of households that are demographically balanced within 53 markets (cities and rural markets) and four Census regions in the United States. About 85% of households represented city markets and about 15% of households were from rural markets. Major city markets were Chicago, Los Angeles, New York, San Francisco, Atlanta, Philadelphia, Baltimore, Washington DC and San Antonio.

Each household was provided with a scanner machine in which they could scan and record all items purchased in different retail trade locations throughout a given time period. Panelists recorded the expenditure and quantity of all items purchased in that household followed by input of demographic information about the household. Demographic information included household size and income, age of the household head, age and presence of children, employment status of the household, race, region, and ethnicity (Hispanic origin).

ACNielsen Homescan data include purchases of all consumer items bought by a household during a specified period of time. However, for our analysis, we used nationally representative purchase data only for food and beverage items. As exhibited in Table 1, we provide the total number of households available for each calendar year from 1998 through 2003. For our analysis, we used household level purchase data for each month within a year. In Table 1, we provide the total number of households in each year that made purchases for all twelve months. Finally, for this study, we had to drop some households from each year due to the inability to calculate a weighted average price of nonalcoholic beverages. In Table 1, we subsequently provide the number of households used in this study as well as thee percentage of households omitted due to missing price information.

Initially, household purchases of NAB were assimilated for each calendar year and converted into annual intakes of calories, calcium, vitamin C and caffeine. From this information, daily per person intakes of these nutritional elements subsequently were calculated by dividing by 365 and dividing this result further by household size. Nutrient information pertaining to calories, calcium, vitamin C, and caffeine was not directly included in Nielsen data. This information was obtained from USDA (see Appendix D of Pittman (2004) for nutrient conversions for nonalcoholic beverages). Units of measurement for calories are expressed in kilocalories per person per day, while calcium, vitamin C and caffeine are expressed in milligrams per person per day.

Data Analysis

According to Table 2, on average for the six-year period (1998 through 2003), at-home consumption of nonalcoholic beverages accounts for 220 kilocalories, 189 milligrams of calcium, 52 milligrams of vitamin C and 83 milligrams of caffeine per head per day. To give above descriptive statistics more perspective, when the daily recommended values for each nutrition category is concerned, through consumption of nonalcoholic beverages at-home, one derives 11% of calories, 19% of calcium, 34% of vitamin C and 41% of caffeine.

As shown in Figure 1, there is a decreasing trend in the caloric intake derived from the consumption of nonalcoholic beverages over the period of 1998 through 2003. We observe a drastic drop in the caloric intake after year 2001. Intake of calcium derived from the consumption of nonalcoholic beverages for the same period is shown in figure 2. Just as in the case of caloric intake, there is a considerable difference in calcium intake after year 2001.

Vitamin C intake derived from the consumption of nonalcoholic beverages increased up to 2000, falling thereafter. This trend is shown in Figure 3. We observe a considerable drop of vitamin C intake after year 2001. According to Figure 4, we see an increasing trend in the intake of caffeine up to 2000, and a downward turn from 2000 to 2001 and from 2001 to 2002. From 2002 to 2003, we observe an uptick in vitamin C intake from the consumption of NAB. As in the case of calories, calcium and vitamin C intake, we observe a notable difference in caffeine intake after year 2001.

The preceding behavior in the intake of those nutrients and calories is in accordance with the dietary guidelines set forth by the United States Department of

Agriculture (USDA) in year 2000.USDA emphasized cutting down on caloric and caffeine intake from food and beverages. One of their major objectives was to help consumers choose beverages and foods sensibly to moderate sugar intake.

Figure 5 shows the consumption of selected nonalcoholic beverages in gallons on a per person per year basis for at-home markets in the USA for the period 1998 through 2003. Regular soft drinks (carbonated non-diet soft drinks) and fruit drinks are two major contributors of added sugars and hence extra calories to the diet derived from beverages. According to Figure 5, per capita consumption of regular soft drinks and fruit drinks is about 11 gallons and 2.9 gallons in 2001 respectively, dropping to about 9.4 gallons and 2.7 gallons in 2003. This drop in the consumption of regular soft drinks and fruit drinks by the US consumer reflects in part the drop in the intake of calories derived from nonalcoholic beverages from 2001 through 2003, the time period immediately following the implementation of the dietary guidelines for Americans by the USDA.

Major contributors for caffeine intake derived from consumption of nonalcoholic beverages are regular soft drinks, coffee and tea. As shown in Figure 5, per capita consumption of regular soft drinks, tea and coffee respectively show a decreasing trend after year 2001. Consumption of tea dropped from about 4.3 gallons in year 2001 to about 3.6 gallons in 2003. Coffee consumption was about 12 gallons in 2001 and it deceased to about 9 gallons in 2003. These decreasing trends in consumption of regular soft drinks, tea and coffee by the US consumer goes hand-in-hand with the declining trends in the intake of caffeine derived from the consumption of nonalcoholic beverages for the same time period.

Even though USDA dietary guidelines advocate increased consumption of calcium and vitamin C, interestingly enough we find that the intake of calcium and vitamin C derived from consumption of nonalcoholic beverages are decreasing over the time from 1998 through 2003. Milk (high fat and low fat) and calcium fortified fruit juices are the major contributors for calcium intake derived from beverages. As exhibited in Figure 5, we find that per capita whole milk consumption in at-home markets was a little above 7 gallons per year in 1998, dropping to about 5.5 gallons in 2003. Figure 5 further shows that per capita at-home consumption of low-fat milk was about 5.7 gallons per year in 1998, dropping to about 3.6 gallons in year 2003. Overall, there is a drop in the total milk consumption, hence a drop in calcium intake derived from milk. The decreasing trend in per capita consumption of fruit juices in at-home markets during the same time period also may be contribute to the decline in intake of calcium derived from beverages.

The drop in the intake of vitamin C derived from consumption of nonalcoholic beverages in at-home markets can be directly attributed to the decreasing trend in the consumption of fruit juices and isotonics. Per capita fruit juice consumption was about 5.8 gallons per year in 1998 in at-home markets, declining to about 4.6 gallons in 2003. Per capita consumption of isotonics also shows a decreasing trend during the time period concerned. Decreasing intake of calcium and vitamin C derived from nonalcoholic beverages consumed in at-home markets can be directly attributed to dwindling trends in milk, fruit juice, and isotonics consumption.

To add more perspective to above trends in different types of beverages consumed at-home, we can state that, caloric and caffeine intake derived from consumption of nonalcoholic beverages were decreasing as a consequence of decreasing consumption of soft drinks, fruit drinks, tea and coffee in at-home markets, fulfilling one of the objectives set forth by the USDA in year 2000 in formulating the Dietary Guidelines for Americans. Furthermore, USDA year 2000 dietary guidelines promote the consumption of water and advise the U.S. consumers to substitute away specifically from beverages with added sugars like soft drinks. The trend in per capita bottled water consumption in the at-home markets as shown in Figure 5 serves as a testimonial to the behavioral change on the part of consumers in drinking increasing amounts of water in lieu of soft drinks.In 1998, per capita bottled water consumption was 3 gallons per year in at-home markets, increasing to more than 5 gallons per year in 2003.

Demographic Analysis

Caloric, calcium, vitamin C and caffeine intake derived from nonalcoholic beverage consumption varies by different demographic characteristics. We support this contention in this section.

Age of household head

Figure 6 shows the six-year average per capita caloric, calcium, vitamin C and caffeine intake per day by age category of household head derived through consumption of nonalcoholic beverages. The noteworthy result is that the caloric intake is high for those households where the household head is under the age of 25 compared to all other age categories. It is also very clear that the older the household head, the more the intake of caffeine, vitamin C and calcium derived through consumption of nonalcoholic beverages. For example, on average, per capita intake of caffeine derived from consumption of nonalcoholic beverages is about 45 mg per day for household heads under age 25 years and it is as high as 105 mg per day for household heads over 64 years of age.

Employment status of household

As shown in Figure 7, households where the household head is not employed for full pay, average per capita intakes of calories, caffeine, calcium and vitamin C derived from consumption of nonalcoholic beverages is high in comparison to those households where the household head is employed for pay (either part time of full time). These data, however, are associated with household at-home consumption of nonalcoholic beverages. Therefore, this result is not too surprising because we suspect that households with employed household heads eat more away-from-home than households where the household head is not employed for full pay.

Education status of household

According to Figure 8, per capita caloric, calcium and caffeine intake derived from nonalcoholic beverages consumed at-home is higher for those household heads with at most a high school education. The more educated the household head, the more the average intake of vitamin C derived from consumption of nonalcoholic beverages at-home. Quite surprisingly, intake of calcium from beverages is lower for household heads with higher levels of education.

Region

As exhibited in Figure 9, households located in the Midwest) and South have higher average per capita intake of calories and calcium derived from consumption of nonalcoholic beverages at-home in comparison to the East and to the West). Average caffeine intake derived from consumption of nonalcoholic beverages is highest in the

East followed by the Midwest. Average intake of vitamin C resulting from consumption on nonalcoholic beverages is higher for those households located in the East and the South in comparison to those located in the West and in the Midwest.

Race

As shown in Figure 10, those households classified as white, black and other have higher caloric intake derived from consumption of nonalcoholic beverages on average than those classified as Oriental. White households have the highest intake of caffeine and calcium derived from consumption of nonalcoholic beverages at-home. Orientals ingest a very low amount of caffeine taken from beverages. Blacks have the lowest intake of calcium from beverages. This lower intake of calcium may be due to their inherent intolerance for milk products. However, blacks have the highest average intake of vitamin C derived from nonalcoholic beverages in comparison to whites, Orientals and other races.

Hispanic origin

On average, as exhibited in Figure 11, per capita daily intake of calories, caffeine, calcium and vitamin C derived from consumption of nonalcoholic beverages are lower for Hispanics than that for non-Hispanics

Age and presence of children in the household

According to Figure 12, households with 13 to 17 year-olds have a higher per capita intake of calories, caffeine and vitamin C derived from consumption of nonalcoholic beverages in comparison to households with children who are less than 13 years. Per capita calcium intake derived from consumption of nonalcoholic beverages is higher for those households with pre-adolescent children. The highest average intake of calcium derived from beverages is among households with children under age 6.

Gender of household head

As exhibited in Figure 13, households headed by males only have higher average per capita intake of calories, caffeine, calcium and vitamin C derived from consumption of nonalcoholic beverages at-home compared to those households headed by females only head as well as those households headed by both males and females

Poverty status of household

Figure 14 shows that households which are below the 185% poverty threshold have intake slightly more caloric intake from beverages than those households that are above this threshold. Furthermore, per capita average intake of caffeine, calcium and vitamin C respectively derived from consumption of nonalcoholic beverages is slightly lower for poverty households compared to that of non-poverty households.

Econometric Analysis

In this section, we discuss the factors affecting the caloric and nutrient intakes of calcium, vitamin C, and caffeine derived from the consumption of NAB. We accomplish this task through the estimation of econometric models. Each nutrition category (caffeine, calcium and vitamin C) and caloric intake is regressed on the weighted average price of nonalcoholic beverages and the aforementioned demographic factors for the period from 1998 through 2003. The sample size for this analysis is 41,071 households.

The econometric model for each nutrient and for calories is given as follows:

$$
\begin{aligned}
Q_i &= \beta_0 + \beta_1 P_i + \beta_2 P_i^2 + \beta_3 A_{1i} + \beta_4 A_{2i} + \beta_5 A_{3i} + \beta_6 A_{4i} + \beta_7 A_{5i} + \beta_8 A_{6i} + \\
&\beta_9 E_{1i} + \beta_{10} E_{2i} + \beta_{11} ED_{1i} + \beta_{12} ED_{2i} + \beta_{13} ED_{3i} + \\
&\beta_{14} R_{1i} + \beta_{15} R_{2i} + \beta_{16} R_{3i} + \beta_{17} RA_{1i} + \beta_{18} RA_{2i} + \beta_{19} RA_{3i} + \\
&\beta_{20} H_i + \beta_{21} AC_{1i} + \beta_{22} AC_{2i} + \beta_{23} AC_{3i} + \beta_{24} AC_{4i} + \beta_{25} AC_{5i} + \beta_{26} AC_{6i} + \beta_{27} AC_{7i} + \beta_{28} M_i + \beta_{29} F_i \\
&\beta_{30} PO_i) + \beta_{31} D01 + \beta_{32} D02 + \beta_{33} D03 + e_i
\end{aligned} \tag{1}
$$

where $i=1,\ldots\ldots T$ the total number of observations (households) in the analysis; Q_i corresponds to the amount of caloric intake (kilocalories per person per day) and nutrient intake (caffeine, calcium and vitamin C in milligrams per person per day) derived from the consumption of nonalcoholic beverages. The right-hand side variables pertain to the weighted price of nonalcoholic beverages and to the various demographic factors discussed previously.

We considered different functional forms such as linear, linear-log, quadratic, log-log and log-linear. We found that the quadratic functional form outperformed other functional forms based on the Box-Cox transformation method. Also given the data structure associated with this analysis, we use generalized least squares in lieu of ordinary least squares to circumvent potential autocorrelation and heteroscedasticity issues. The level of significance chosen for this analysis is 0.05.

It is noteworthy to address the marginal impact of price on the level of caloric or nutrient intake given the fact that a quadratic functional form is used for the econometric models. Let the intake of calories, calcium, caffeine and vitamin C be denoted by Q_i. The quantity of nonalcoholic beverages associated with each of the respective intakes is represented by Q_{NAB}. P_{NAB} is the weighted average price of nonalcoholic beverages. Then it follows that

$$\frac{\partial Q_i}{\partial P_{NAB}} = \frac{\partial Q_i}{\partial Q_{NAB}} * \frac{\partial Q_{NAB}}{\partial P_{NAB}} \quad (2)$$

In words, the change of intake of calories and other nutrients with respect to a change of price of nonalcoholic beverages (i.e. $\frac{\partial Q_i}{\partial P_{NAB}}$) can be decomposed into the product of change of intake of calories and other nutrients due to a change in the quantity consumed of nonalcoholic beverages (i.e. $\frac{\partial Q_i}{\partial Q_{NAB}}$) as well as the change in the quantity consumed of nonalcoholic beverages due to a change in price of the corresponding nonalcoholic beverage category (i.e. $\frac{\partial Q_{NAB}}{\partial P_{NAB}}$). Considering all nonalcoholic beverages as a single good, from the law of demand we know that $\frac{\partial Q_{NAB}}{\partial P_{NAB}}$ must have a negative sign (the own-price effect). As the quantity of nonalcoholic beverages consumed changes, caloric and nutrient (calcium, caffeine and vitamin C) intakes may either increase, decrease, or remain the same. That is, the sign of $\frac{\partial Q_i}{\partial Q_{NAB}}$ depends on the composition of the nonalcoholic beverages consumed. Therefore, the sign of $\frac{\partial Q_i}{\partial P_{NAB}}$ is indeterminate.

We now provide a discussion of each of the econometric results for calories, calcium, caffeine, and vitamin C derived from NAB. Emphasis is placed on the factors affecting the intakes as well as differences in intakes between the years 1998, 1999, and 2000 (the reference period) and the years 2001, 2002, and 2003. Consequently, we are in position to determine whether or not the implementation of the Dietary Guidelines in 2000 was effective in bringing about desired changes in caloric and nutrient intakes.

Factors affecting caloric intake: 1998 through 2003

In Table 3, we present the econometric results concerning caloric intake over the period 1998 to 2003. Price, employment and education status of the household, region, race, age and presence of children, gender of the household food manager, and poverty status are significant factors determining the intake of calories from consumption of nonalcoholic beverages.

Owing to the quadratic functional form, the marginal effect of price on caloric intake is a function of price, namely 64.94283-17.700316*price. Given that the average price paid for nonalcoholic beverages during the period in question is $2.38 per gallon, this marginal impact is positive. Also from this result, the price of nonalcoholic beverages associated with the maximum intake of calories is $3.67 per gallon, all other factors invariant.

Households where household head is employed full-time or part-time have significantly lower caloric intake in comparison to those households where the household head is not employed for full pay. In particular, this intake is lower by 27 and 13 kilocalories per person per day for full-time and part-time employed households respectively.

The more educated the household head, the lower the caloric intake by consuming nonalcoholic beverages. This intake is 27 kilocalories lower for those households that have some post-college education compared to those households with less than a high school education. As well, caloric intake is lower by about 18 kilocalories for those households have some college education compared to those households with less than a high school education.

Households located in the Midwest consume about 10 kilocalories per person per day more calories than those located in the East. However, households located in the West consume about 23 kilocalories per person per day less than those households located in the East.

Black households and households from other races categories consume 11 and 15 kilocalories per person per day respectively more than those households classified as white. Oriental households consume about 40 kilocalories per person per day less than those households classified as white.

Age and presence of children also is a significant factor in determining the caloric intake derived from nonalcoholic beverages. More specifically, caloric intake is lower for those households with children compared to those with out children.

Households headed by a male only consume 79 kilocalories per person per day more than those households headed by both a male and a female. The caloric intake of poverty households is higher by six kilocalories per person per day than that of non-poverty households.

We find that, per capita caloric intake per day derived from consumption of nonalcoholic beverages at-home is significantly lower in years 2001 through 2003 compared to that of years 1998 through 2000. In 2001, caloric intake was lower by eight kilocalories per person per day and lower by 37 kilocalories per person per day in years 2002 and 2003 compared to that of the reference period, 1998 through 2000. This result sheds light on the effectiveness of the USDA year 2000 Dietary Guidelines designed in part to reduce the intake of beverages to moderate the intake of sugars, and hence, extra calories.

Factors affecting caffeine intake: 1998 through 2003

In Table 4, we present the econometric analysis of the factors affecting caffeine intake derived from consumption of nonalcoholic beverages at-home from 1998 through 2003. Statistically significantly factors affecting caffeine intake are price, age, employment and education status of the household head, region, race, age and presence of children, gender of the household head, and poverty status of the household.

The marginal effect of price on caffeine intake is expressed as -106.7801+23.07414*price. Given that the average price of nonalcoholic beverages over the 1998 to 2003 period is $2.38 per gallon, this marginal impact is negative. From this finding, one may calculate the weighted average price of nonalcoholic beverages to minimize caffeine intake. This price turns out to be $4.63 per gallon.

Older household heads have higher the per capita intakes of caffeine per day. The highest caffeine intake is among the households where the household head is between 55 to 64 years old. Full and part-time employed households consume about 3mg of caffeine less than those households who are not employed for full pay. Higher-educated household heads have less caffeine intake derived from nonalcoholic beverages. More specifically, caffeine intakes of households with college and post-college education are lower by about 7mg compared to household heads with less than a high school education.

Caffeine intakes of households located in the Midwest, the South, and the West are lower by 6, 7 and 2mg of caffeine respectively per person per day than those households located in the East. Intakes of black and Oriental households are lower by 22 and 14mg respectively than caffeine intakes of white households.

Households with children have lower caffeine intakes per person per day than those households without children. Intakes of households headed by a male only and intakes of households headed by a female only are higher by 21mg and by 9mg respectively than those households headed by both males and females. Caffeine intakes of poverty households are lower by roughly 5mg per person per day than intakes of non-poverty households.

Per capita caffeine intake per day derived from consumption of nonalcoholic beverages at-home is significantly lower in years 2002 through 2003 compared to that of in years 1998, 1999 and 2000. This finding is on par with the expectations of the USDA year 2000 Dietary Guidelines and food guide pyramid, where it is advised to curtail the intake of caffeinated beverages and concentrate more on decaffeinated diet soft drinks (with low added sugar content) as beverages choices.

Factors affecting calcium intake: 1998 through 2003

In Table 5, we show the econometric analysis of the factors affecting the intake of calcium derived from consumption of nonalcoholic beverages. Price, gender and employment status of the household head, region, race, Hispanic origin, and age and presence of children are significant drivers of calcium intake.

The marginal effect of price on calcium intake is given as 32.93535-12.436176*price Given that the average price paid for nonalcoholic beverages is $2.38 per gallon over the period 1998 to 2003, this marginal impact is positive. From this result, the price of nonalcoholic beverages associated with the maximum intake of calcium is $2.65 per gallon, all other factors invariant.

Households where the household head is employed full-time or part-time have a lower intake of calcium from beverages compared to those of households where the household head is not employed for full pay. Households located in the Midwest, the South, and the West have higher intakes of calcium by 29, 12 and 6mg respectively than households located in the East. Calcium intakes of blacks, Orientals, and other races are much lower than those of whites. In particular, intake of calcium for blacks is 82mg lower than for whites; intakes of calcium for Orientals and other races also are lower by 62 and 21mg compared to whites.

Households with Hispanic origin consume 15mg of calcium less relative to households classified as non-Hispanic. Presence of children in a household significantly reduces the calcium intake from beverages. Calcium intakes of households headed by a male only are higher per person per day than those households headed by both a male and a female.

Per capita intake in calcium is lower by 10, 33 and 34mg in years 2001, 2002 and 2003 respectively in contrast to that of in years1998, 1999 and 2000. The USDA 2000 Dietary Guidelines for Americans recognize the importance of calcium intake either from food/beverages sources or from supplements. However, there may be reasons for the decline in calcium intake derived through consumption of nonalcoholic beverages at-home. First, there is a possibility that while consumers are trying to reduce the intake of calories and caffeine by cutting back on the consumption of nonalcoholic beverages, intake of calcium drops as a consequence. Second, consumers may be substituting away from nonalcoholic beverages to other non-beverage choices for calcium intake. According to the USDA 2000 Dietary Guidelines, some of the other alternative calcium sources are yogurt, cheese, soy-based products with added calcium, tofu made with calcium sulfate, breakfast cereal with added calcium, canned fish with soft bones such as salmon and sardines, and dark green vegetables (collards, turnip greens). Third, some consumers may satisfy their daily calcium intake through supplements and simultaneously move away from nonalcoholic beverages. Finally, our study captures only at-home consumption of nonalcoholic beverages and ignores the consumption of nonalcoholic beverages away from home.

Factors affecting vitamin C intake: 1998 through 2003

In the Table 6, we illustrate the factors affecting per capita intake of vitamin C per day taken in from consumption of nonalcoholic beverages at-home. Significant factors that are affecting the intake of vitamin C are price, gender, age, employment and education status of the household head, region, race, age and presence of children, and poverty status.

The marginal effect of price on vitamin C intake is given as 19.51129-1.769564*price. Given that the average price paid for nonalcoholic beverages is $2.38 per gallon over the 1998 to 2003 period, this marginal impact is positive, just as in the case of calories and calcium. From this result, the price of nonalcoholic beverages associated with the maximum intake of vitamin C is $11.03 per gallon.

Intakes of vitamin C of older household heads are higher per person per day. The highest vitamin C intake is among the household heads who are over 64 years, which is about 8mg more compared to those who are below 25 years. Full-time (part-time) employed household heads consume 7mg (5mg) of vitamin C less in comparison to those who are not employed for full pay.

Intakes of vitamin C are higher for those household heads who are more educated. Households where the household head has a high school, some college and post college education consume 3, 4, and 6mg of vitamin C more than those households where the household head does not have a high school education.

The highest vitamin C intake is among households located in the East. More specifically, this intake is higher by about 14mg compared to that of households located in the West and about 6mg higher relative to those located in the Midwest and in the South..

Intakes of vitamin C are higher for households without children than for households with children. Households headed by males only have intakes of vitamin C that are higher by 19mg compared to households headed by both male and females. Poverty households receive about 3mg of vitamin C less compared to those who are categorized as non-poverty.

Intake of vitamin C is lower by 2, 8 and 9mg respectively for years 2001, 2002 and 2003 compared to that of years 1998, 1999 and 2000. Possible reasons for the decline in the intake of vitamin C may be the following. First, decreased consumption of fruit juices and drinks (powdered soft drinks like fruit ades and fruit punch) occurred to reduce the intake of added sugars, thus extra calories. Second, just as in the case with calcium, consumers may be substituting away from nonalcoholic beverage choices. Even though the USDA 2000 Dietary Guidelines advocate the intake of citrus juices as a means of vitamin C intake, they also place a greater weight on one obtaining vitamin C through consumption of a wide variety of fresh fruits and vegetables, such as citrus fruits, kiwi fruit, strawberries, cantaloupe, broccoli, tomatoes and leafy greens like spinach. Third, some consumers may opt for supplements rather than depending on nonalcoholic beverages. Finally, again, our study revolves only around at-home consumption, ignoring away-from-home consumption of NAB.

Concluding Remarks

Obesity among all walks of life is one of the most urgent and widely emphasized nutrition-related health problems in America today. With the publication of the 2000 and 2005 USDA Dietary Guidelines for Americans, the role of beverages in the American diet increased in attention. The 2000 Guidelines gave prominence to the role of soft drinks and other sweetened beverages in the U.S. obesity epidemic. The 2005 Guidelines reiterated the need to limit calories from soft drinks.

Our findings demonstrate the nutritional contribution of nonalcoholic beverages consumed at-home to the U.S. diet. Beverage choices made by households have impacts on determining the intake of calories, calcium, caffeine, and vitamin C on a daily basis.

Consumption of nonalcoholic beverages adds on various kinds of nutrients to the diet. Vitamin C and calcium are two of healthy required nutrients that come from consumption of nonalcoholic beverages. Caffeine is another ingredient that is found in some nonalcoholic beverages which is considered to be non-healthy in excessive amounts. Most of all, consumption of nonalcoholic beverages adds extra sugars (calories) to the diet. According to the American Beverage Association (2006), beverage producing companies have responded positively to the changing needs and interests of consumers by introducing many low-calorie, zero-calorie, calcium fortified, and decaffeinated beverage choices.

Many government programs targeting nutritional enhancement of households, such as The Food Stamp Program, National School Lunch Program, School Breakfast Program, and Special Supplemental Food Program for Women, Infants and Children (WIC), are in need of most current information pertaining to nonalcoholic beverage consumption. Therefore, demographic profiling of households that consume nonalcoholic beverages, hence nutrient intake, is important to identify the proper target group for such government programs.

Price, gender, employment and education status of the household head, region, race, poverty status, age and the presence of children were statistically important in the determination of daily caloric intake from the consumption of nonalcoholic beverages. Statistically significant factors in determining the daily calcium intake derived from nonalcoholic beverages for the same time period are price, employment status and gender of the household head, region, race, Hispanic origin, year and age and presence of children. Employment status, gender and education level of the household head, race, and region, presence of children and poverty status of the household head were the key drivers associated with daily availability of vitamin C. Age, employment and education status and gender of the head of the household head, region, race, year, presence of children and household poverty status were primary determinants of daily caffeine intake per person.

When yearly dummies were used to ascertain the impact of year 2000 USDA Dietary Guidelines, we found that there were significant drops in caloric, calcium, vitamin C and caffeine in year 2001, 2002 and 2003 compared to that of 1998, 1999 and 2000, our reference years. That is to say, the 2000 USDA Dietary Guidelines have been successful in reducing caloric and caffeine intake derived from nonalcoholic beverage consumption at home. The reduction in calcium intake may be due to the decline in milk consumption, substituting away from nonalcoholic beverages to food products such as cheese and yogurt, and the use of supplements. The drop in vitamin C intake derived from NAB consumption probably is due to the fact that USDA Dietary Guidelines emphasized eating fresh fruits and vegetables compared to drinking nonalcoholic beverages. Also consumers may obtain vitamin C from supplements.

Study Limitations

Limitations exist to our study warranting attention. Our study concentrates on at-home consumption of nonalcoholic beverages. The away-from-home intake of beverages is not accounted for in our analysis. Also our analysis does not capture the substitution away from beverage choices to non-beverage choices such as consumption of fresh fruits and vegetables. As well, intakes from the use of dietary supplements are not captured. Nonetheless, this study demonstrates to some degree the effectiveness of the USDA intervention program, the 2000 Dietary Guidelines, in reducing intakes of calories and nutrients derived from the consumption of nonalcoholic beverages.

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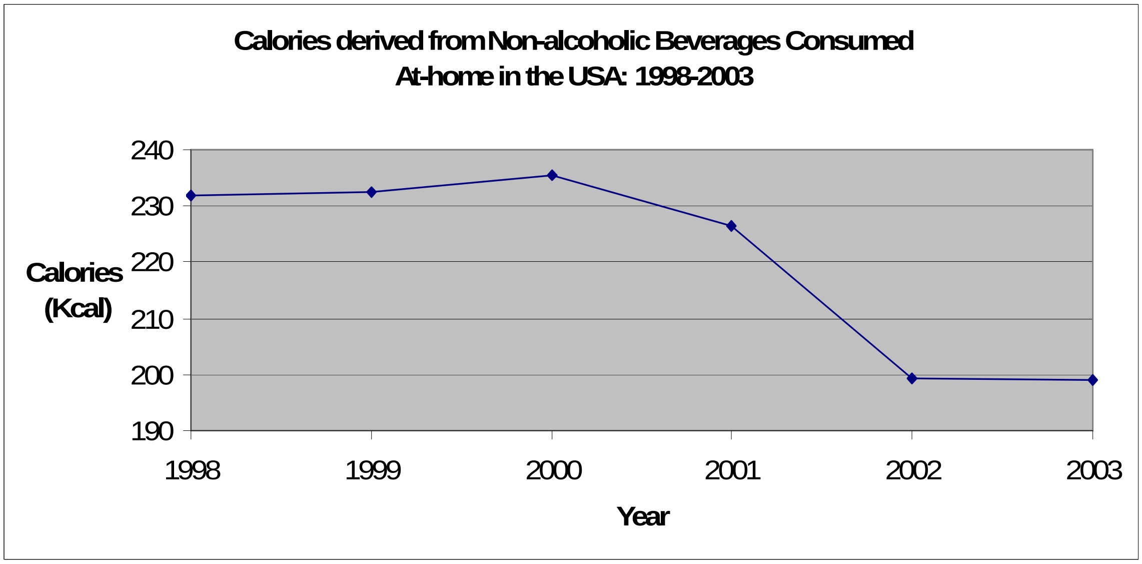

Figure 1: **Calories derived from Nonalcoholic Beverages Consumed At-home in the USA: 1998-2003**

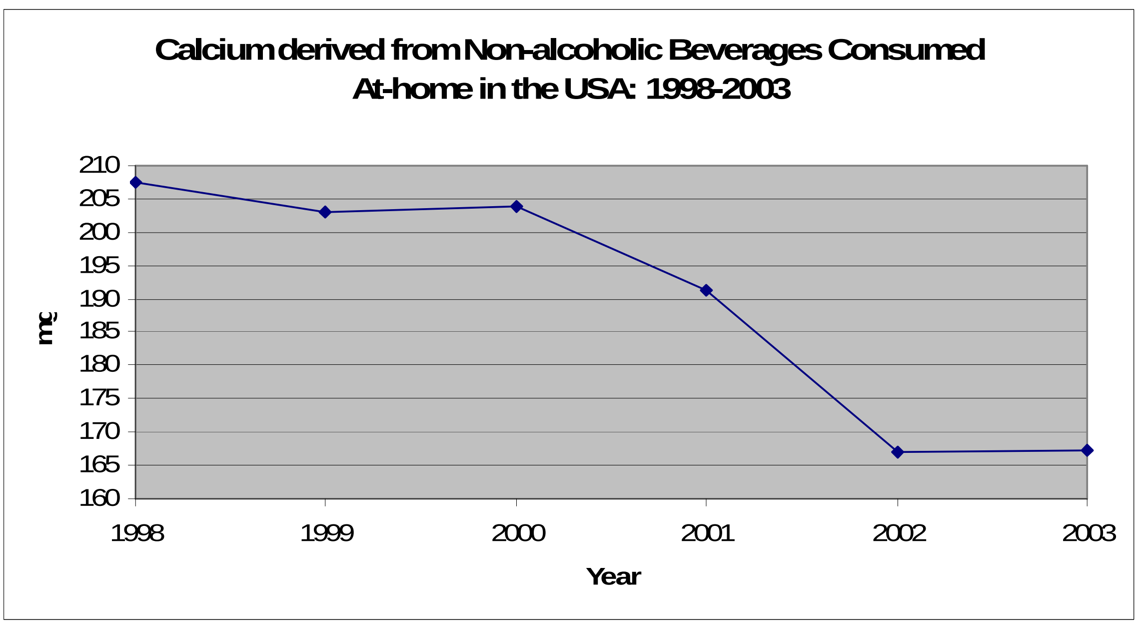

Figure 2: **Calcium derived from Nonalcoholic Beverages Consumed At-home in the USA: 1998-2003**

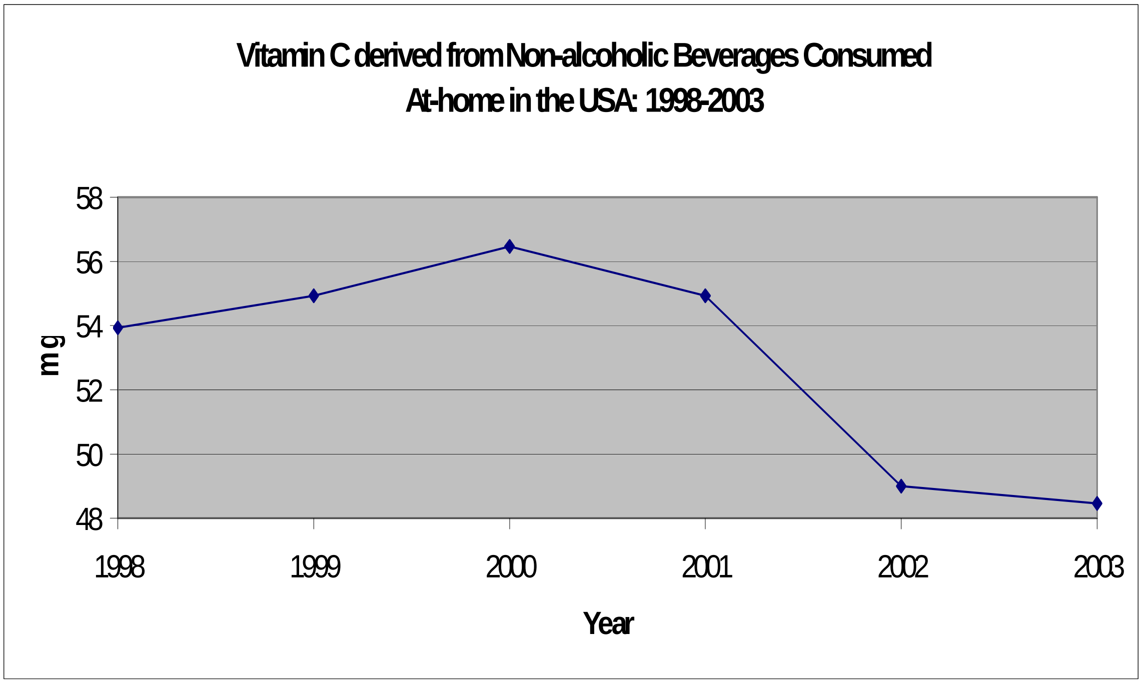

Figure 3: **Vitamin C derived from Nonalcoholic Beverages Consumed At-home in the USA: 1998-2003**

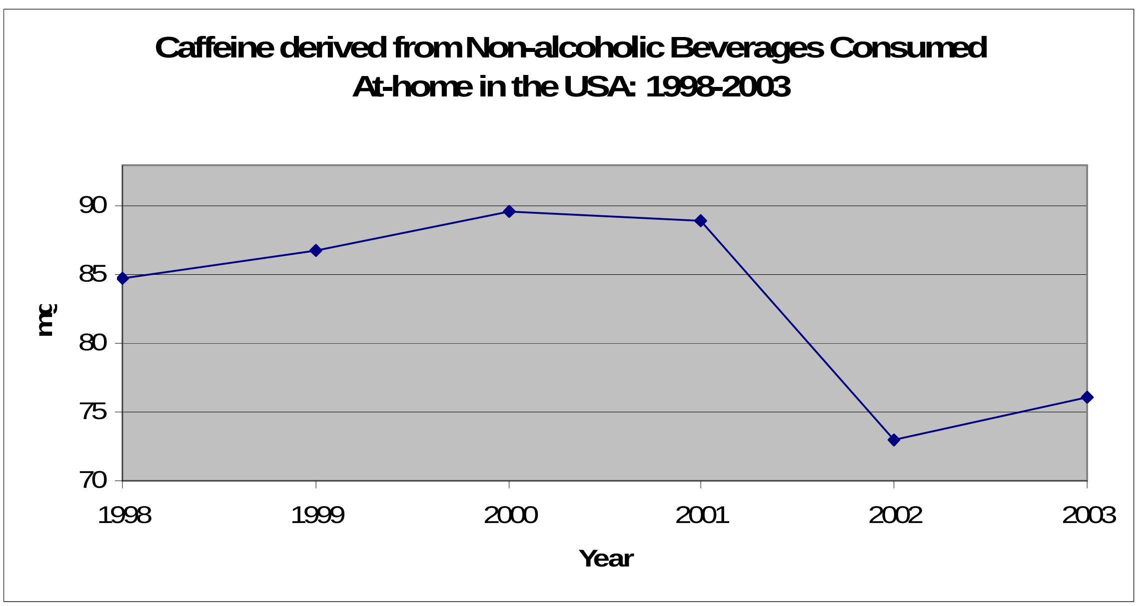

Figure 4: **Caffeine derived from Nonalcoholic Beverages Consumed At-home in the USA: 1998-2003**

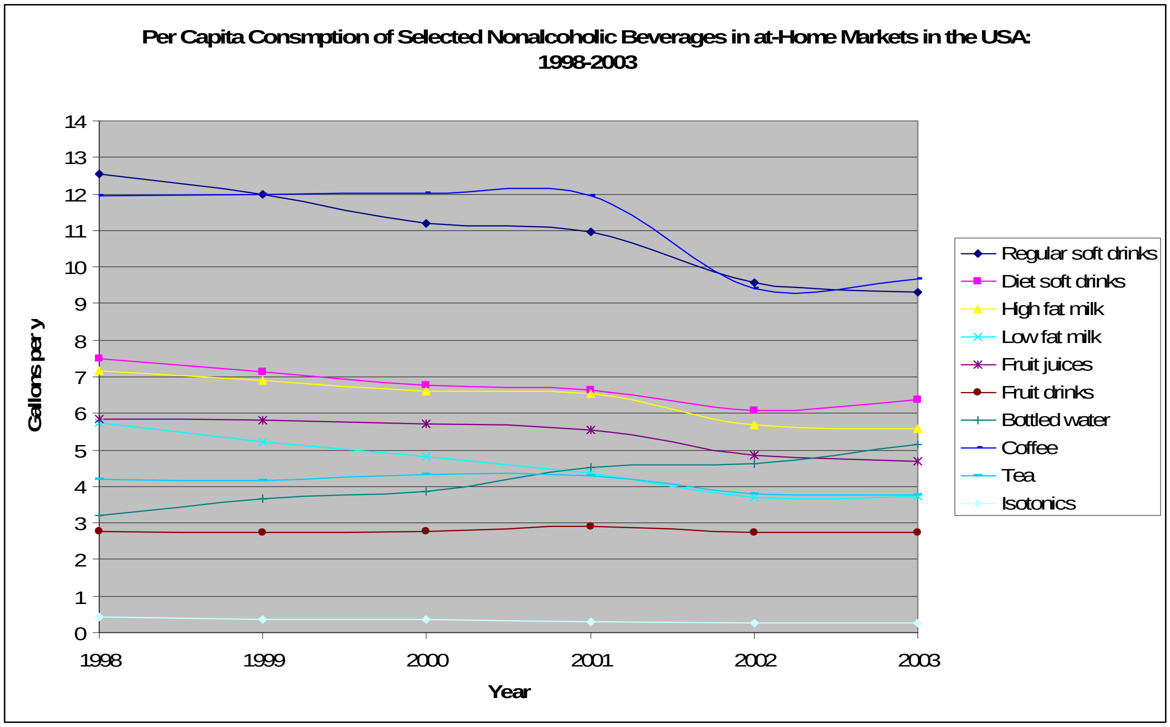

Figure 5: Per Capita Consumption of Selected Nonalcoholic Beverages in at-Home Markets in the USA: 1998-2003

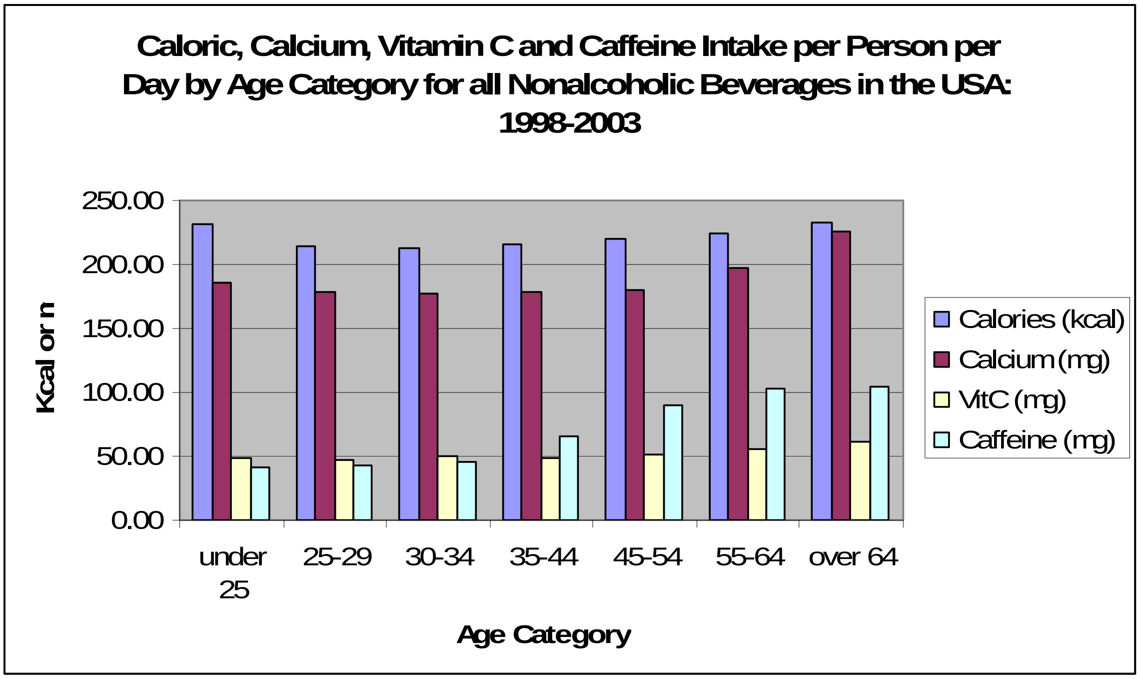

Figure 6: Per Capita Caloric, Calcium, Vitamin C and Caffeine Intake per Day by Age Category for all Non- alcoholic Beverages in the USA at-Home Markets: 1998-2003

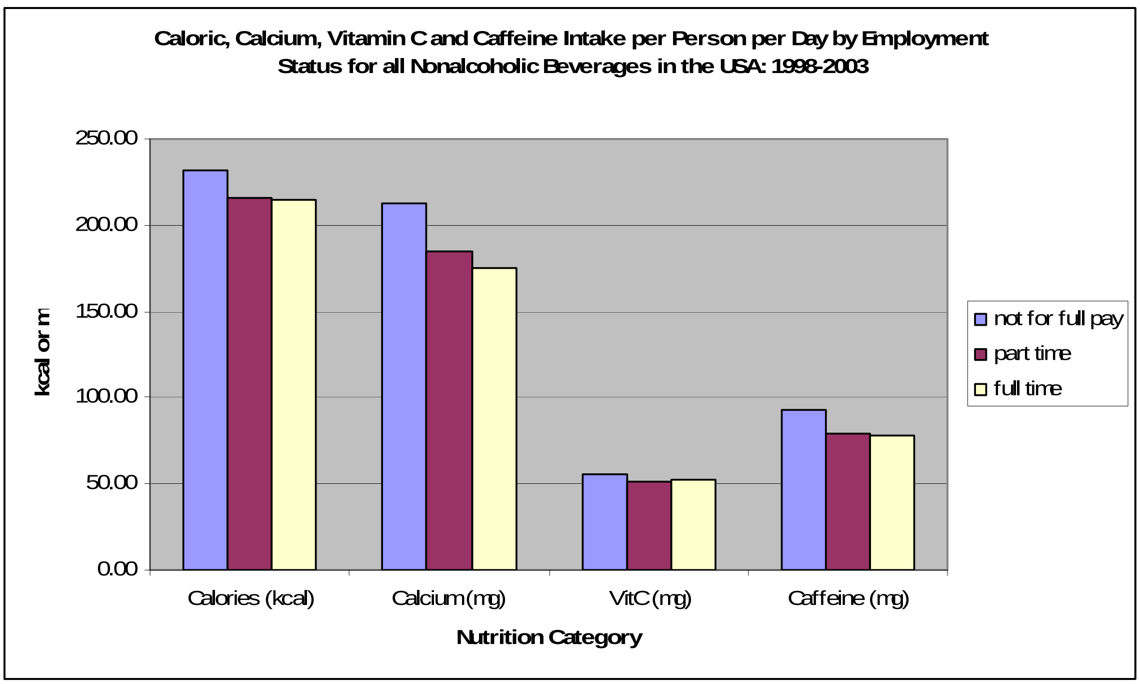

Figure 7: Per Capita Caloric, Calcium, Vitamin C and Caffeine Intake per Day by Employment Status for all Non- alcoholic Beverages in the USA at-Home Markets: 1998-2003

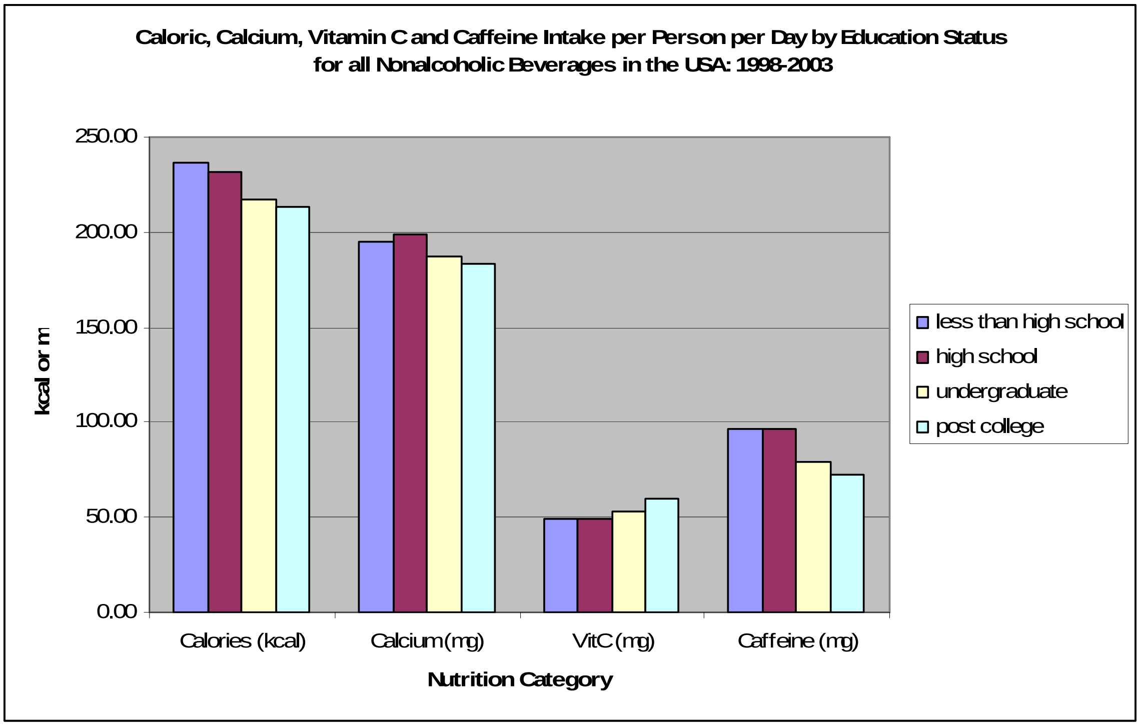

Figure 8: **Per Capita Caloric, Calcium, Vitamin C and Caffeine Intake per Day by Education Status for all Non- alcoholic Beverages in the USA at-Home Markets: 1998-2003**

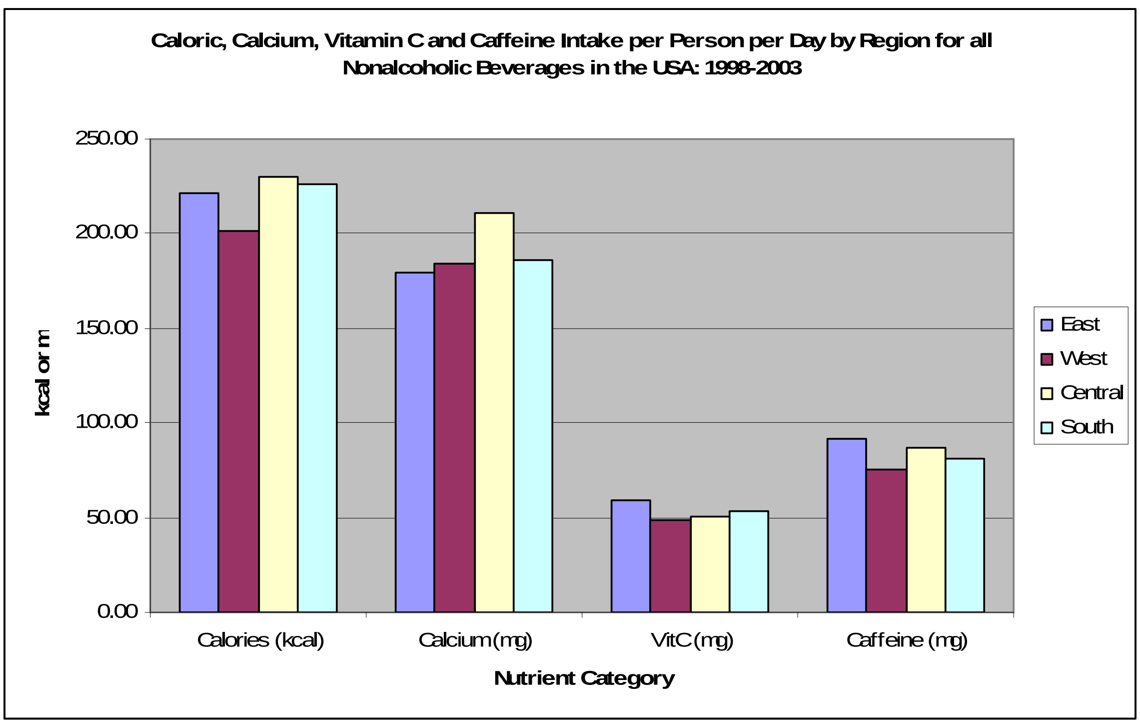

Figure 9: **Per Capita Caloric, Calcium, Vitamin C and Caffeine Intake per Day by Region for all Non- alcoholic Beverages in the USA at-Home Markets: 1998-2003**

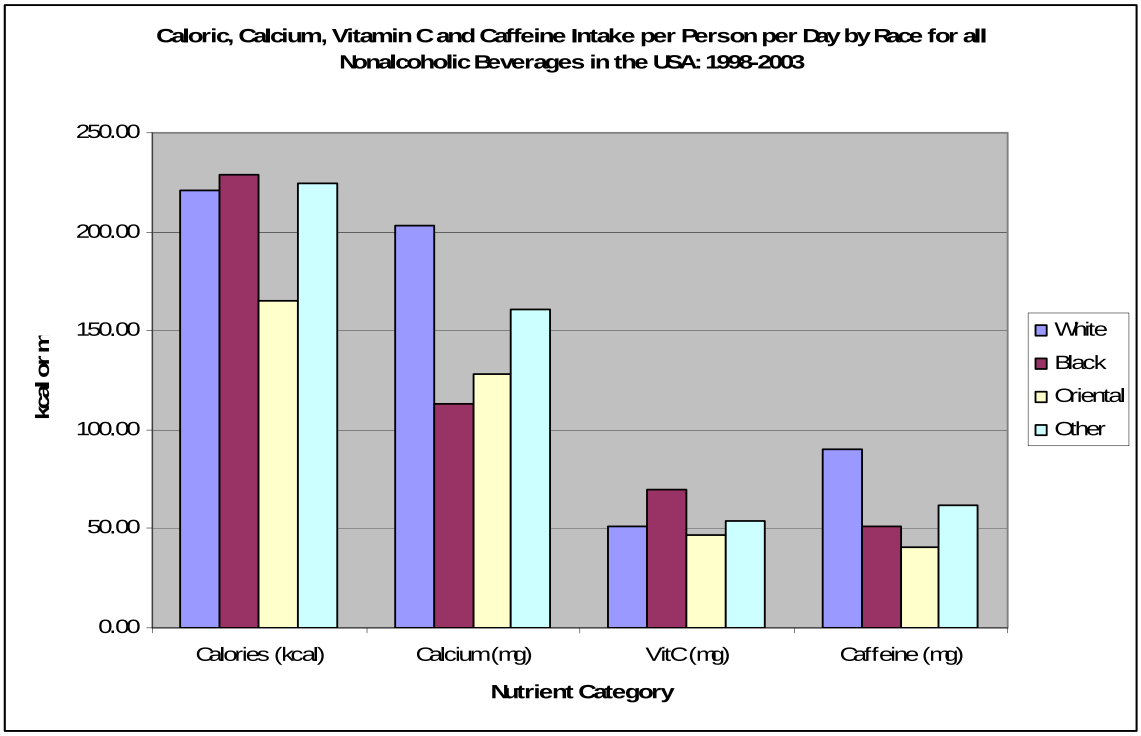

Figure 10: **Per Capita Caloric, Calcium, Vitamin C and Caffeine Intake per Day by Race for all Non- alcoholic Beverages in the USA at-Home Markets: 1998-2003**

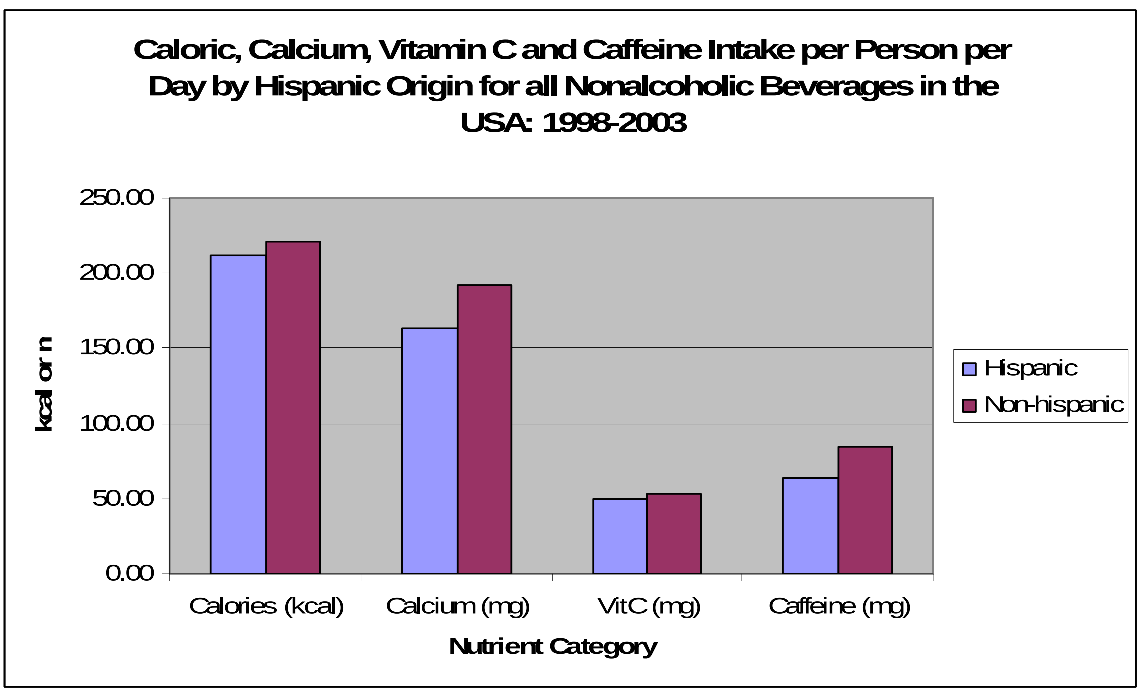

Figure 11: **Per Capita Caloric, Calcium, Vitamin C and Caffeine Intake per Day by Hispanic Origin for all Non- alcoholic Beverages in the USA at-Home Markets: 1998-2003**

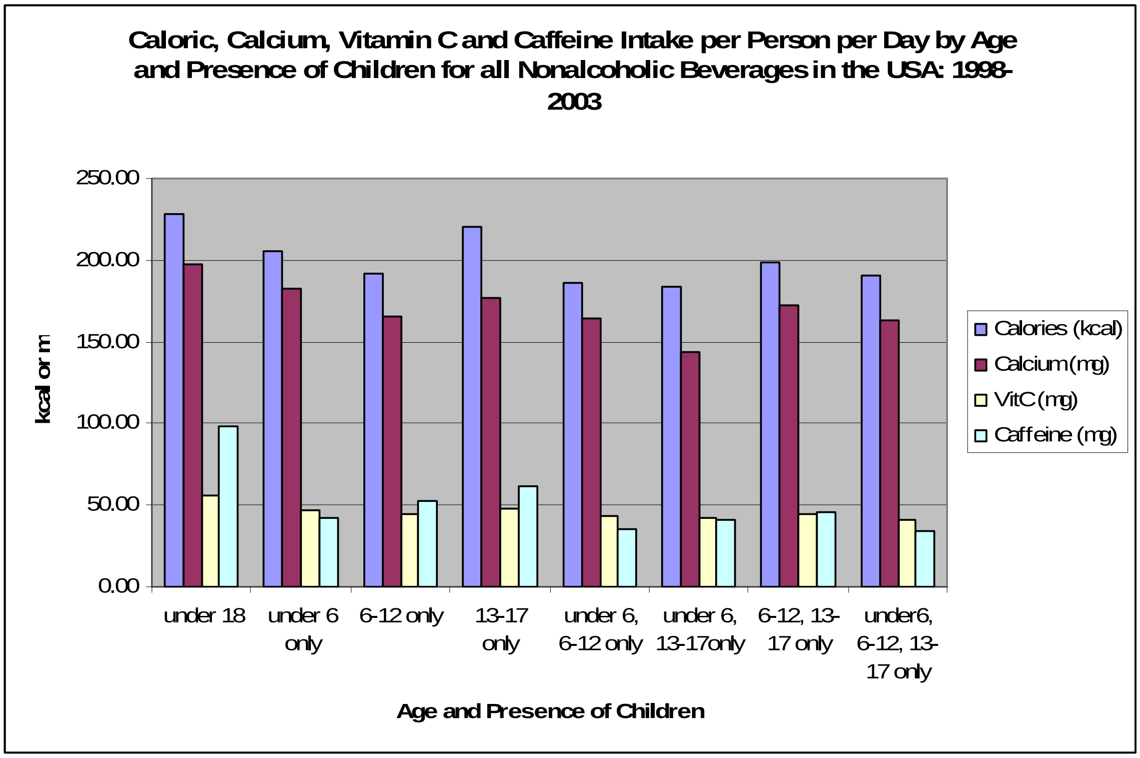

Figure 12: Per Capita Caloric, Calcium, Vitamin C and Caffeine Intake per Day by Age and Presence of Children for all Non- alcoholic Beverages in the USA at-Home Markets: 1998-2003

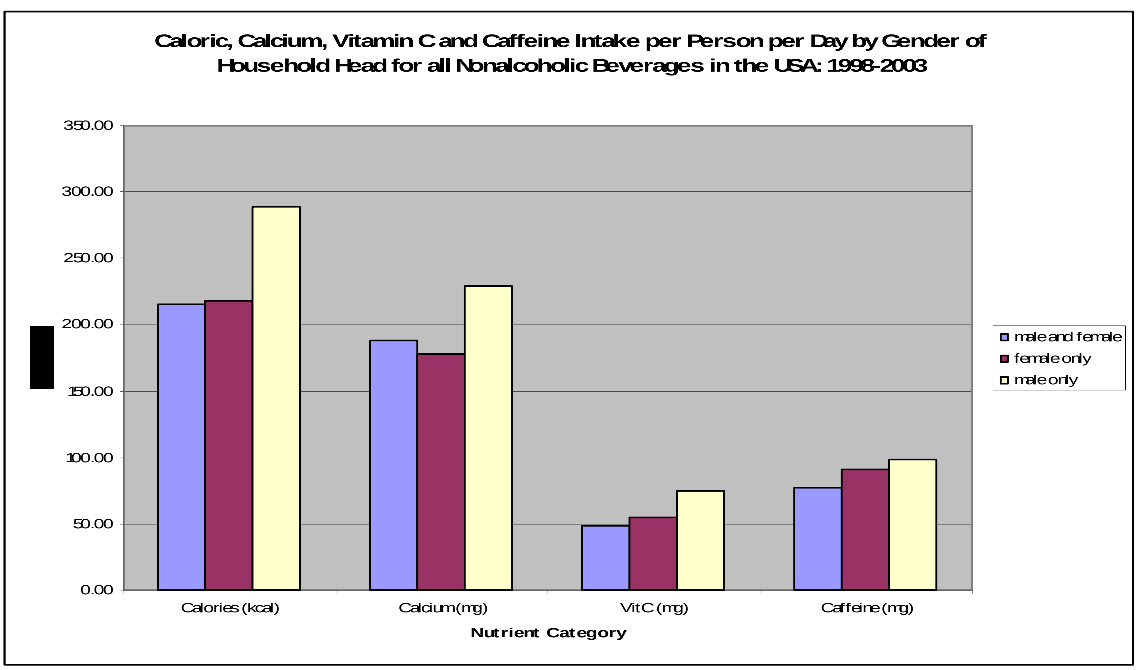

Figure 13: Per Capita Caloric, Calcium, Vitamin C and Caffeine Intake per Day by Gender of Household Head for all Non- alcoholic Beverages in the USA at-Home Markets: 1998-2003

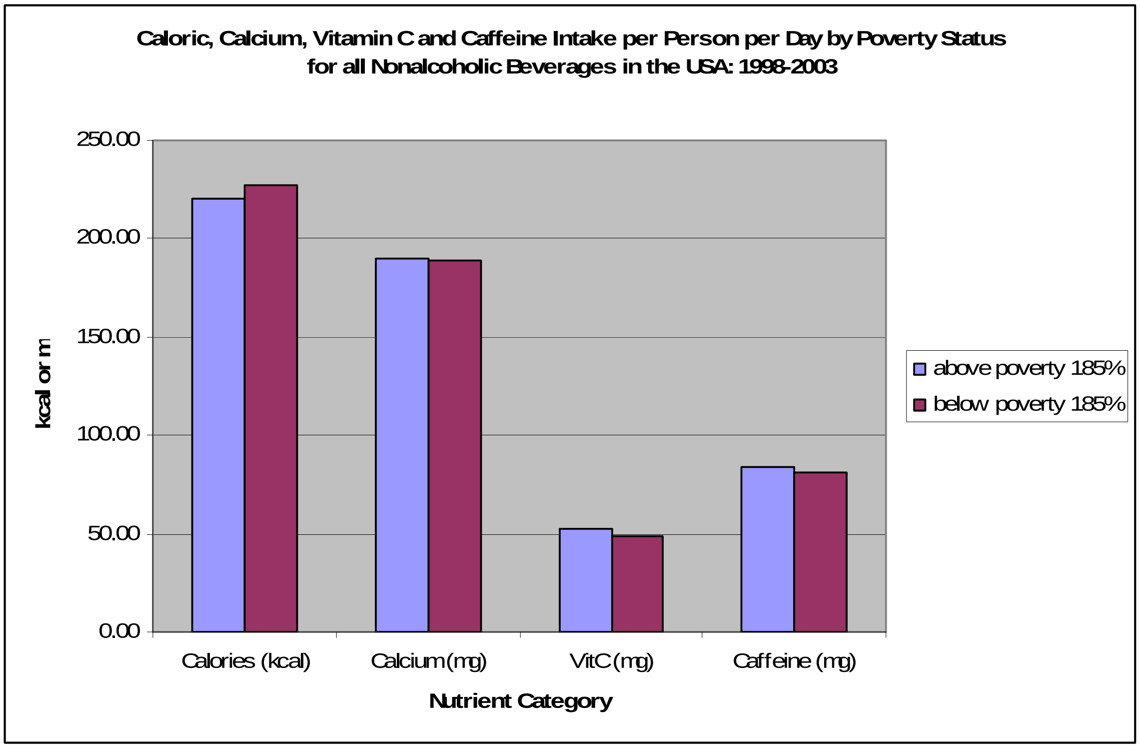

Figure 14: Per Capita Caloric, Calcium, Vitamin C and Caffeine Intake per Day by Poverty Status for all Non- alcoholic Beverages in the USA at-Home Markets: 1998-2003

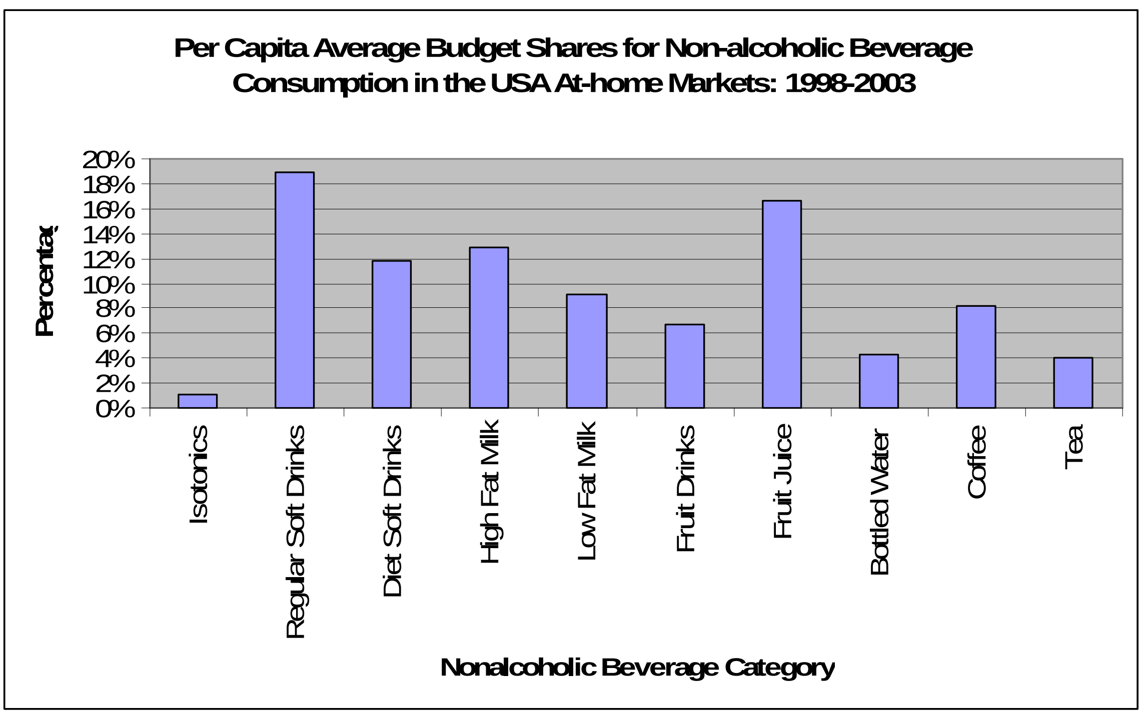

Figure 15 Per Capita Average Annual Budget Shares of Nonalcoholic Beverage Consumption in the US at-home markets: 1998-2003

Table 1: Number of households available and used in the study for each calendar year: 1998 through 2003

Year	Total number of households available	Total number of households with 12 months purchases	Total number of households used in the nutrition study	Percentage of households dropped due to missing price information
1998	7624	6116	6087	0.47%
1999	7124	6397	6376	0.33%
2000	7523	6600	6555	0.68%
2001	8216	7142	7103	0.55%
2002	8685	7439	7384	0.74%
2003	8833	7642	7566	0.99%

Table 2: Summary Statistics of Intake of Calories, Calcium, Caffeine and Vitamin C per Person per Day: Derived from Consumption of Nonalcoholic Beverages in US At-home Markets: 1998-2003

	Calories (Kcal/head/day)	Calcium (mg/head/day)	Caffeine (mg/head/day)	Vitamin C (mg/head/day)
Mean	220.40	189.19	83.17	52.88
Median	187.67	145.52	50.37	39.13
SD	164.76	166.85	118.27	50.55
Minimum	0.22	0.13	0.01	0.002
Maximum	11297.95	6254.10	11633.19	878.03
Daily Recommended	2000	1000	200	155
Percentage Consumed at-home	11	19	41	34

Table 3: Econometric Results from Caloric Intake 1998-2003

Dependent Variable: CALORIES
Sample: 1 41071

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	171.6798	12.12736	14.15641	0.0000
PRICE	64.94283	3.739707	17.36576	0.0000
PRICE2	-8.850158	0.631577	-14.01280	0.0000
AGEHH2529	-5.337837	10.56349	-0.505310	0.6133
AGEHH3034	-2.042827	10.12367	-0.201787	0.8401
AGEHH3544	-5.492394	9.914460	-0.553978	0.5796
AGEHH4554	-8.316217	9.906467	-0.839473	0.4012
AGEHH5564	-11.36994	9.969655	-1.140455	0.2541
AGEHHGT64	-16.84977	10.09611	-1.668937	0.0951
EMPHHPT	-13.43815	2.451993	-5.480502	0.0000
EMPHHFT	-27.52520	2.141644	-12.85237	0.0000
EDUHHHS	-0.228936	4.592537	-0.049850	0.9602
EDUHHU	-17.81678	4.475897	-3.980604	0.0001
EDUHHPC	-27.75611	5.025927	-5.522584	0.0000
REG_CENTRAL	9.843264	2.406647	4.090033	0.0000
REG_SOUTH	2.972269	2.183434	1.361282	0.1734
REG_WEST	-22.94704	2.487532	-9.224824	0.0000
RACE_BLACK	11.16282	2.587352	4.314382	0.0000
RACE_ORIENTAL	-40.47082	5.795420	-6.983241	0.0000
RACE_OTHER	15.33988	4.434100	3.459526	0.0005
HISP_YES	-3.335413	3.708455	-0.899408	0.3684
AGEPCLT6_ONLY	-23.69002	4.289057	-5.523365	0.0000
AGEPC6_12ONLY	-33.78231	3.345016	-10.09930	0.0000
AGEPC13_17ONLY	-0.195008	3.100152	-0.062903	0.9498
AGEPCLT6_6_12ONLY	-45.99540	4.539501	-10.13226	0.0000
AGEPCLT6_13_17ONLY	-45.12102	10.07729	-4.477497	0.0000
AGEPC6_12AND13_17ONLY	-25.83306	3.981439	-6.488372	0.0000
AGEPCLT6_6_12AND13_17	-41.23147	8.768315	-4.702325	0.0000
MHONLY	79.45617	2.851119	27.86841	0.0000
FHONLY	6.522487	2.031161	3.211212	0.0013
POV185	6.324630	2.517911	2.511857	0.0120
D2001	-8.123482	2.239786	-3.626901	0.0003
D2002	-35.84420	2.217386	-16.16507	0.0000
D2003	-36.72877	2.208974	-16.62707	0.0000

Weighted Statistics

R-squared	0.054771	Mean dependent var	220.1355
Adjusted R-squared	0.054011	S.D. dependent var	164.9065
S.E. of regression	160.5634	Akaike info criterion	12.99608
Sum squared resid	1.06E+09	Schwarz criterion	13.00322
Log likelihood	-266847.0	F-statistic	72.05676
Durbin-Watson stat	1.994115	Prob(F-statistic)	0.000000

Table 4: Econometric Results from Caffeine Intake 1998-2003

Dependent Variable: CAFFEINE

Sample: 1 41071

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	262.8606	6.034197	43.56182	0.0000
PRICE	-106.7801	2.168870	-49.23306	0.0000
PRICE2	11.53707	0.319694	36.08784	0.0000
AGEHH2529	5.465256	4.581237	1.192965	0.2329
AGEHH3034	11.25969	4.389437	2.565179	0.0103
AGEHH3544	20.31039	4.311269	4.711001	0.0000
AGEHH4554	22.62695	4.310889	5.248789	0.0000
AGEHH5564	24.90986	4.346897	5.730493	0.0000
AGEHHGT64	20.56925	4.412544	4.661540	0.0000
EMPHHPT	-3.397131	1.165894	-2.913756	0.0036
EMPHHFT	-3.118414	1.013144	-3.077958	0.0021
EDUHHHS	-0.784375	2.366216	-0.331489	0.7403
EDUHHU	-6.331240	2.293817	-2.760134	0.0058
EDUHHPC	-7.714966	2.475355	-3.116711	0.0018
REG_CENTRAL	-6.532467	1.156297	-5.649470	0.0000
REG_SOUTH	-6.728186	1.021214	-6.588421	0.0000
REG_WEST	-2.179317	1.099072	-1.982870	0.0474
RACE_BLACK	-21.66671	1.159498	-18.68628	0.0000
RACE_ORIENTAL	-13.86962	2.270278	-6.109215	0.0000
RACE_OTHER	-1.140404	1.950340	-0.584721	0.5587
HISP_YES	-3.097255	1.666959	-1.858027	0.0632
AGEPCLT6_ONLY	-21.41220	1.874197	-11.42473	0.0000
AGEPC6_12ONLY	-23.82135	1.540689	-15.46149	0.0000
AGEPC13_17ONLY	-19.48379	1.457556	-13.36743	0.0000
AGEPCLT6_6_12ONLY	-30.17815	2.051912	-14.70733	0.0000
AGEPCLT6_13_17ONLY	-36.21430	5.080301	-7.128377	0.0000
AGEPC6_12AND13_17ONLY	-32.50254	1.918906	-16.93806	0.0000
AGEPCLT6_6_12AND13_17	-37.80656	4.329979	-8.731351	0.0000
MHONLY	20.63125	1.211228	17.03333	0.0000
FHONLY	9.038028	0.933472	9.682166	0.0000
POV185	-4.895213	1.261554	-3.880304	0.0001
D2001	1.844437	1.034638	1.782688	0.0746
D2002	-7.854899	1.014205	-7.744881	0.0000
D2003	-6.181949	1.007113	-6.138287	0.0000

Weighted Statistics

R-squared	0.176696	Mean dependent var	69.78638
Adjusted R-squared	0.176034	S.D. dependent var	81.07271
S.E. of regression	78.48088	Akaike info criterion	11.56441
Sum squared resid	2.53E+08	Schwarz criterion	11.57155
Log likelihood	-237447.0	F-statistic	266.8869
Durbin-Watson stat	1.989475	Prob(F-statistic)	0.000000

Table 5: Econometric Results from Calcium Intake 1998-2003

Dependent Variable: CALCIUM
Sample: 1 41071

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	177.9176	11.88357	14.97174	0.0000
PRICE	32.93535	3.080492	10.69159	0.0000
PRICE2	-6.218088	0.472763	-13.15267	0.0000
AGEHH2529	-2.235441	10.52159	-0.212462	0.8317
AGEHH3034	0.734660	10.08492	0.072847	0.9419
AGEHH3544	-0.441121	9.880219	-0.044647	0.9644
AGEHH4554	-2.919589	9.873038	-0.295713	0.7675
AGEHH5564	3.229476	9.938010	0.324962	0.7452
AGEHHGT64	16.49868	10.06651	1.638968	0.1012
EMPHHPT	-21.92706	2.465976	-8.891839	0.0000
EMPHHFT	-28.03351	2.152550	-13.02340	0.0000
EDUHHHS	5.576739	4.658234	1.197179	0.2312
EDUHHU	-1.220993	4.537934	-0.269064	0.7879
EDUHHPC	-2.748268	5.070589	-0.542002	0.5878
REG_CENTRAL	28.62467	2.422457	11.81638	0.0000
REG_SOUTH	12.33538	2.192420	5.626374	0.0000
REG_WEST	5.690264	2.482987	2.291701	0.0219
RACE_BLACK	-82.05642	2.588580	-31.69939	0.0000
RACE_ORIENTAL	-62.18195	5.707143	-10.89546	0.0000
RACE_OTHER	-20.95750	4.421993	-4.739380	0.0000
HISP_YES	-14.76653	3.707664	-3.982704	0.0001
AGEPCLT6_ONLY	-3.563275	4.272236	-0.834054	0.4043
AGEPC6_12ONLY	-15.06553	3.349938	-4.497256	0.0000
AGEPC13_17ONLY	-3.260683	3.111500	-1.047946	0.2947
AGEPCLT6_6_12ONLY	-24.64131	4.536045	-5.432334	0.0000
AGEPCLT6_13_17ONLY	-30.68322	10.18313	-3.013142	0.0026
AGEPC6_12AND13_17ONLY	-9.291599	4.005207	-2.319880	0.0204
AGEPCLT6_6_12AND13_17	-20.10737	8.842003	-2.274074	0.0230
MHONLY	50.92474	2.833485	17.97247	0.0000
FHONLY	-1.014895	2.036123	-0.498445	0.6182
POV185	-3.221909	2.545749	-1.265604	0.2057
D2001	-10.53338	2.246650	-4.688482	0.0000
D2002	-33.37135	2.221314	-15.02325	0.0000
D2003	-33.97757	2.212363	-15.35804	0.0000

Weighted Statistics

R-squared	0.070651	Mean dependent var	189.1573
Adjusted R-squared	0.069903	S.D. dependent var	166.7763
S.E. of regression	160.8762	Akaike info criterion	12.99997
Sum squared resid	1.06E+09	Schwarz criterion	13.00711
Log likelihood	-266927.0	F-statistic	94.53656
Durbin-Watson stat	1.991204	Prob(F-statistic)	0.000000

Table 6: Econometric Results from Vitamin C Intake 1998-2003

Dependent Variable: VITC

Sample: 1 41071

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.78598	3.591059	4.674382	0.0000
PRICE	19.51129	1.438581	13.56287	0.0000
PRICE2	-0.884782	0.282799	-3.128665	0.0018
AGEHH2529	-2.089064	3.055648	-0.683673	0.4942
AGEHH3034	0.767602	2.927195	0.262231	0.7931
AGEHH3544	0.076920	2.863760	0.026860	0.9786
AGEHH4554	1.661279	2.860737	0.580717	0.5614
AGEHH5564	4.631497	2.877332	1.609650	0.1075
AGEHHGT64	8.446354	2.911768	2.900765	0.0037
EMPHHPT	-2.505200	0.690149	-3.629943	0.0003
EMPHHFT	-7.243426	0.603577	-12.00084	0.0000
EDUHHHS	3.056549	1.264371	2.417447	0.0156
EDUHHU	4.095766	1.233523	3.320382	0.0009
EDUHHPC	5.892683	1.403209	4.199435	0.0000
REG_CENTRAL	-6.857752	0.676094	-10.14320	0.0000
REG_SOUTH	-6.257107	0.616615	-10.14751	0.0000
REG_WEST	-13.80309	0.712647	-19.36876	0.0000
RACE_BLACK	20.23899	0.736893	27.46531	0.0000
RACE_ORIENTAL	-2.966056	1.715690	-1.728784	0.0839
RACE_OTHER	7.007114	1.272382	5.507082	0.0000
HISP_YES	0.341736	1.059868	0.322433	0.7471
AGEPCLT6_ONLY	-6.260194	1.241558	-5.042209	0.0000
AGEPC6_12ONLY	-7.768063	0.954080	-8.141938	0.0000
AGEPC13_17ONLY	-2.704434	0.878939	-3.076928	0.0021
AGEPCLT6_6_12ONLY	-8.939837	1.303912	-6.856165	0.0000
AGEPCLT6_13_17ONLY	-9.088623	2.812354	-3.231679	0.0012
AGEPC6_12AND13_17ONLY	-4.446071	1.123460	-3.957481	0.0001
AGEPCLT6_6_12AND13_17	-6.757473	2.460020	-2.746918	0.0060
MHONLY	18.65166	0.823808	22.64079	0.0000
FHONLY	1.380501	0.575420	2.399119	0.0164
POV185	-2.695495	0.697939	-3.862078	0.0001
D2001	-1.673092	0.634126	-2.638420	0.0083
D2002	-8.595919	0.629582	-13.65338	0.0000
D2003	-9.363007	0.627646	-14.91767	0.0000

Weighted Statistics

R-squared	0.094769	Mean dependent var	51.41504
Adjusted R-squared	0.094041	S.D. dependent var	47.47578
S.E. of regression	45.96854	Akaike info criterion	10.49462
Sum squared resid	86715557	Schwarz criterion	10.50176
Log likelihood	-215478.2	F-statistic	130.1869
Durbin-Watson stat	1.984469	Prob(F-statistic)	0.000000