Influence of Price and Labeling on Energy Drink Purchasing in an Experimental Convenience Store

Jennifer L. Temple, PhD1,2,3, Amanda M. Ziegler, MPH1; Leonard H. Epstein, PhD2,4,5

ABSTRACT

Objective: To examine the impact of energy drink (ED) pricing and labeling on the purchase of EDs.
Methods: Participants visited a laboratory-based convenience store 3 times and purchased a beverage under different ED labeling (none, caffeine content, and warning labels) and pricing conditions. The 36 participants (aged 15–30 years) were classified as energy drink consumers (≥ 2 energy drinks/wk) and nonconsumers (< 1 energy drink/mo). Data were log transformed to generate elasticity coefficients. The authors analyzed changes in elasticity as a function of price and labeling using mixed-effects regression models.
Results: Increasing the price of EDs reduced ED purchases and increased purchasing of other caffeinated beverages among ED consumers. Energy drink labels affected ED sales in adolescents.
Conclusions and Implications: These data suggest that ED pricing and labeling may influence the purchasing of ED, especially in adolescent consumers.

Key Words: caffeine, energy drinks, Food and Drug Administration, pricing, labels (J Nutr Educ Behav. 2016;48:54-59.)

Accepted August 9, 2015. Published online September 26, 2015.

INTRODUCTION

Caffeine is the most widely used psychoactive substance in the world.1 Caffeine is classified as Generally Recognized as Safe by the Food and Drug Administration (FDA), but the influx of highly caffeinated energy drinks (EDs) marketed to adolescents and young adults has prompted the FDA to consider regulating nonalcoholic caffeine-containing beverages for the first time in over 6 decades.2 Some potential regulations include adding caffeine content or warning labels, restricting sales of EDs to minors, and taxing EDs. To date, no studies have investigated the impact of such strategies on ED purchasing and consumption.

Behavioral economic principles state that as the cost of a product increases, purchasing of that product decreases.3 Behavioral economic approaches have been used to study a range of purchasing behavior to predict the price at which purchasing decreases. Examining the impact of price changes on the purchasing of foods and beverages provides empirical data on the effectiveness of taxes and subsidies. Studies in vending machines,4 restaurants,5 and cafeterias6,7 have shown that increasing the price of less healthy food decreases purchases. One study using a laboratory-based grocery store showed that selective taxation of high-calorie-for-nutrient food decreased the total energy purchased, with the greatest influence on energy from fats and carbohydrates.8

Another factor that influences purchasing of beverages and foods is labeling. To provide consumers with nutrition information, the FDA requires labels on all packaged foods.9 It is possible that providing information about caffeine content on beverages would also be beneficial10 and may allow consumers to better regulate caffeine intake.11 Empirical data on the relationship between food labeling and food purchasing are weak and inconsistent. Two studies reported that providing calorie information at the point of purchase reduced energy purchased12,13 but the majority showed that point-of-purchase labeling did not affect purchasing or consumption.14-17

The purpose of this study was to test the hypotheses that (1) increasing the price of EDs decreases purchasing of EDs in consumers, and (2) adding labels that provide more information about EDs reduces purchasing of EDs in consumers. In addition, the relationship between changes in ED purchasing and purchasing of potential substitute beverages was examined in a laboratory-based convenience store.
METHODS

Participants

Participants aged 15–30 years were recruited using direct mailings, flyers, and word of mouth from January to June, 2014. Potential participants were screened by telephone for medical and demographic information as well as amount of caffeine and EDs used on a daily or weekly basis. Eligible participants had no known allergies to the study foods and beverages and had not had an adverse reaction to caffeine. Individuals classified as non-ED consumers (consumed EDs less than once per month) or ED consumers (consumed EDs 2 or more times per week) were enrolled. The researchers chose the population of non-ED consumers as a comparison group to make sure that the experimental environment and procedures would not entice individuals who would not normally purchase EDs to try them. Potential participants were excluded if they reported consuming EDs between once per month and once per week, if they were not willing or able to visit the laboratory 3 times, or if they were pregnant. A total of 36 15– to 30-year-olds (n = 18 males and 18 females) were eligible and completed the study during the recruitment period. Participants in this age range were chosen because data suggest that ED use is rising fastest in adolescents and young adults.

Procedures

Each participant visited the laboratory 3 times between 11 AM and 7 PM, with 1–3 days between each appointment. At the beginning of the first visit, participants completed consent and demographic forms. For participants aged 15–17 years, parents completed consent forms and a demographic questionnaire. All other visit documents, including an assent form, were completed by the adolescent participant. Participants then completed a caffeine use questionnaire. Participants were told that the purpose of the study was to determine how different factors influence convenience store purchasing. Then, participants were given $6.00 to purchase food and beverages from the laboratory-based convenience store. After each trial, the participants left the room while the shelves were restocked and the prices of EDs were changed. Participants then completed another purchasing trial and were allowed to keep the purchases from 1 of the 3 trials on each visit. Each visit included an assent form, were completed by the adolescent participant. Participants then completed a caffeine use questionnaire. All other visit documents, including graphic forms. For participants aged 15–30 years, parents completed consent and demographic information. In addition, medical conditions or medications being taken that may influence responses to caffeine, such as attention deficit hyperactivity disorder were reported during screening. Finally, participants were asked to report whether they had ever had an adverse reaction to caffeine.

The researchers measured height and weight using a digital scale and stadiometer (SECA, Hanover, MD, 2008) at the end of the third visit. On the basis of the height and weight data, body mass index (BMI) or BMI percentile was calculated using the Centers for Disease Control and Prevention BMI Calculators according to the following formula: (BMI = kg/m²). The caffeine use questionnaire was designed to assess sources, amounts, and frequency of caffeinated beverage and substance intake in adolescents and young adults. The authors used answers on this questionnaire to determine average daily caffeine intake (milligrams per day). Questions for each beverage included Do you drink _____? If yes, How often do you drink _____? with the following choices: 1 time/mo, 2–3 times/mo, 1 time/wk, 2–3 times/wk, 4–5 times/wk, or every day. When there was a range, the midpoint was selected. Then, participants were asked to provide a volume of beverage consumed on a typical day: 1 can, 2 cans ... more than 7 cans. Beverages listed on the questionnaire were as follows: soda with caffeine, tea (hot or iced), coffee, and energy drinks.

Convenience Store

The experimental convenience store used for this study contained 50 items with the following product distribution: 40% beverages, 10% potato chips/pretzels, 10% cookies/donuts, 15% candy, 6% gum, 6% miscellaneous salty snacks (nuts and beef jerky), 8% granola and cereal bars/toaster pastries, and 5% fruit. Ratios of products were determined by visiting 3 area convenience stores and cataloguing all items, putting them into categories, and calculating ratios of product categories.

Questionnaires and Measurements

A demographic questionnaire providing information about household income, education, profession, and race/ethnicity was completed. In addition, medical conditions or medications being taken that may influence responses to caffeine, such as attention deficit hyperactivity disorder were reported during screening. Finally, participants were asked to report whether they had ever had an adverse reaction to caffeine.

Debriefing

Participants underwent a structured debriefing. During this debriefing, participants were asked what they believed the nature of the experiment was and how they felt about the experiment. They were then told the purpose of the experiment and were compensated.
Analytic Plan

Participant characteristics were examined using ANOVA for continuous variables and chi-squared for categorical variables, with ED consumer group and sex as the between-subjects factors. Purchasing of EDs and other foods and beverages were analyzed using separate mixed-effects regression models (MRM).28 Mixed-effects regression models allow for the evaluation of repeated measures,28 which is necessary in this study because of the different pricing and labeling conditions. The following is an example of an MRM for ED purchasing as a function of changing ED price:

Log of servings of EDs purchased = α + β1(Log of ED price) + β2(ED consumer group) + β3(ED labeling condition) + β4(daily caffeine consumption) + β5(sex)

The dependent variable in this model is the logarithm of the total number of servings of EDs purchased and β1 is the coefficient for the log price of the EDs. In this model, β1 represents the price elasticity of the demand for EDs: the relationship between the percent change in the price of EDs and the percent change in the number of servings of EDs purchased. In addition to the above model, this study examines the impact of ED pricing and labeling on the servings of EDs purchased in adolescents (aged 15–17 years; n = 10) and adults (aged 18–30 years; n = 26) separately. Potential substitutes were examined by log transforming the number of servings of other beverages and performing a similar MRM to that illustrated above, with ED consumption group, daily caffeine consumed, and sex as time invariant predictors and log of the ED price and the log of the ED servings purchased as time variant predictors. Elasticity coefficients were calculated for the other beverages as well. For the substitute analysis, this study examined other beverages individually, but also examined coffee and tea combined and all caffeinated beverages combined. These data were analyzed using SYSTAT (version 11.0, Systat Software, Inc, San Jose, CA, 2005) and data were considered significant when P < .05.

RESULTS

Participant Characteristics

This study included 36 participants aged 15–30 years (18 females and 18 males). Participants were classified as non-ED consumers (< 1 ED/mo; n = 9 males and females) or ED consumers (≥ 2 EDs/wk; n = 9 males and 9 females). Age and daily caffeine consumption did not differ by ED consumption group or by sex, but BMI was lower in males than in females (F[1, 29] = 5.2; P = .03). The average age was 20.4 ± 0.7 years, average BMI was 26.9 ± 1.3 kg/m², and average daily caffeine intake was 202.4 ± 46.3 mg (Table).

Own-Price Elasticity for EDs

Estimates for own-price elasticity were significant for ED purchasing (β = −1.7; P < .001). This elasticity coefficient indicates that for every 10% increase in the price of EDs, the number of servings of EDs purchased decreased by 17% (Figure 1). The same relationships were found when the analyses were repeated in adolescents (β = −3.2; P < .001) and adults (β = −1.25; P = .003) separately. When ED consumers and nonconsumers were analyzed separately, own-price elasticity was significant in both nonconsumers (β = −2.5; P = .01) and consumers (β = −1.95; P < .001), with the stronger effect in ED consumers.

Cross-Price Elasticity

The estimates for cross-price elasticity in the entire sample were significant for purchasing of other caffeinated beverages (β = 1.1; P < .001) and soda (including noncaffeinated; β = .72; P = .003), with caffeinated beverage purchasing increasing by 11% and soda purchasing increasing by 7% for every 10% increase in ED price. When the analyses were repeated in each age group separately, similar cross-price elasticities for other caffeinated beverages (β = 2.37; P = .02) and soda (β = 2.35; P = .04) were found in adolescents but not in adults (β = .50; P = .45) and (β = 1.04; P = .09), respectively.

Energy Drink Labels Affect ED Purchasing in Adolescents

Mixed-effects regression analysis revealed that none of the labeling conditions affected ED purchasing, nor did labels interact with price to influence purchasing when the researchers analyzed the entire study population (all P > .05). However, when adolescents and adults were analyzed separately, there was a significant impact of ED labeling on ED purchasing in adolescents (β = −1.23; P = .007) but not in adults (β = .43; P = .36), with caffeine content and warning labels decreasing ED purchasing compared with the no-label condition (Figure 2).

DISCUSSION

This study contributes to the existing literature by examining the behavioral economic impacts on ED purchasing, and it may contribute to the understanding of the efficacy of potential changes in the sales of EDs. The major finding from this study was that increasing the price of EDs decreased purchasing. This is consistent with behavioral economic theory1 and suggests that increases of 50% to 100% in the price of EDs may discourage ED purchasing. Additional findings of note are that at the reference price, 2 adult non-ED consumers chose to purchase an ED. This suggests that some individuals may be curious about EDs and may purchase them in situations in which they have the money and the opportunity to purchase them, although this finding should be interpreted with caution because the sample size was small. No non-ED consumers purchased EDs when the price was increased. Second, none of the ED consumers purchased EDs at the 100% increased price, which was $3.12/serving. This suggests that ED consumers are sensitive to price manipulations and that increasing the price of these drinks may decrease ED purchasing among youth. Another finding was that as the price of EDs increased, adolescent ED consumers...
switched to purchasing other caffeinated products. This suggests that adolescent ED consumers are using other caffeinated products as a substitute for EDs.

When adolescents and adults were analyzed separately, adolescent ED consumers reduced the number of servings in the caffeine content and warning label conditions relative to the no-label condition. Energy drink labeling has been proposed as a potential strategy to deter ED purchasing, especially among adolescents. These data suggest that the adolescent population may be sensitive to labeling, but that this would not have an impact among adult ED consumers. Most research on labeling has been conducted in the context of nutrition labeling and food purchasing. These studies have shown that nutrition labels do not alter purchasing of healthy foods in most adults or most adolescents. Studies on nutrition labels have shown that certain populations use them to make purchasing decisions, such as lean, health-conscious women or individuals with nutrition-related diseases such as diabetes or hypertension. It is possible that certain adult consumer groups would benefit from ED labeling, such as individuals taking medication that may interact with caffeine or adults who are concerned about caffeine exposure in their children. One potential difference between nutrition and ED labeling is that information about the caffeine content or the potential hazards of consuming caffeine may be more novel to adolescents than to adults, and thus may be more likely to have an impact.

This study had several strengths. First, although the study was based in the laboratory, there were real foods and beverages that represented typical convenience store items available for purchase. Second, participants were allowed to take their purchases home, which increased motivation to make choices that accurately reflected the foods and beverages they wanted to consume. Third, the researchers used a population that was balanced both for sex and ED consumption patterns, so that the impact of price and labeling on both consumers and nonconsumers of EDs along with potential sex differences could be examined. Fourth, a within-subjects design was used, which reduced variability and allowed for the impact of price and labels within individuals to be determined. This study also had limitations. First, it had a relatively small sample size, which may have limited the ability to observe interactions between pricing and labeling conditions. Second, there was an equal number of consumers and nonconsumers, but because the primary outcome variable was ED purchasing, the authors did not observe much

### Table. Descriptive Characteristics of Study Sample, Separated by Sex and Energy Drink Category

<table>
<thead>
<tr>
<th>Category</th>
<th>Non–Energy Drink Consumers</th>
<th>Energy Drink Consumers</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males (n = 9)</td>
<td>Females (n = 9)</td>
<td></td>
</tr>
<tr>
<td>Age, y (mean ± SEM)</td>
<td>19.8 ± 1.7</td>
<td>19.2 ± 1.2</td>
<td>.62</td>
</tr>
<tr>
<td>Body mass index, kg/m² (mean ± SEM)</td>
<td>22.8 ± 1.3</td>
<td>29.2 ± 2.4*</td>
<td>.03</td>
</tr>
<tr>
<td>Average daily caffeine consumption, mg/d (mean ± SEM)</td>
<td>159.2 ± 74.6</td>
<td>111.8 ± 36.2</td>
<td>.95</td>
</tr>
<tr>
<td>Race, n (%)</td>
<td></td>
<td></td>
<td>.19</td>
</tr>
<tr>
<td>Asian</td>
<td>2 (25)</td>
<td>1 (11)</td>
<td></td>
</tr>
<tr>
<td>Black or African American</td>
<td>1 (13)</td>
<td>2 (22)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>5 (62)</td>
<td>5 (56)</td>
<td></td>
</tr>
<tr>
<td>Other or mixed</td>
<td>0</td>
<td>1 (11)</td>
<td></td>
</tr>
<tr>
<td>Education, n (%)</td>
<td></td>
<td></td>
<td>.38</td>
</tr>
<tr>
<td>High school</td>
<td>1 (11)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>3 (33)</td>
<td>5 (56)</td>
<td></td>
</tr>
<tr>
<td>Completed college</td>
<td>1 (11)</td>
<td>3 (33)</td>
<td></td>
</tr>
<tr>
<td>Graduate school</td>
<td>4 (44)</td>
<td>1 (11)</td>
<td></td>
</tr>
<tr>
<td>Income, n (%)</td>
<td></td>
<td></td>
<td>.22</td>
</tr>
<tr>
<td>&lt; $30,000</td>
<td>4 (44)</td>
<td>2 (22)</td>
<td></td>
</tr>
<tr>
<td>$30,000 to $50,000</td>
<td>1 (11)</td>
<td>3 (33)</td>
<td></td>
</tr>
<tr>
<td>$50,000 to $70,000</td>
<td>0</td>
<td>2 (22)</td>
<td></td>
</tr>
<tr>
<td>$70,000 to $110,000</td>
<td>2 (22)</td>
<td>1 (11)</td>
<td></td>
</tr>
<tr>
<td>&gt; $110,000</td>
<td>2 (22)</td>
<td>1 (11)</td>
<td></td>
</tr>
</tbody>
</table>

NS indicates not significant.

*P = .03.

Note: The researchers collected descriptive and socioeconomic variables using questionnaires and anthropomorphic measurements and analyzed them as a function of sex and energy drink consumer group. Continuous data were analyzed using ANOVA and categorical data were analyzed using chi square. Body mass index was significantly greater in female participants than in males (P = .03), but no other factors were significantly different.
change in nonconsumers. It might have been more beneficial to recruit a larger sample of ED consumers and focus on that population or to include a sample of occasional ED consumers who might be more sensitive to these manipulations. Third, although the use of real foods and beverages was a strength, the experimental convenience store lacked the variety that would be found in a real convenience store, which may have limited purchasing choices. Fourth, the warning label used in this study was not pilot-tested in any other studies, nor were data collected after the task to determine whether participants noticed the information on the labels. Although the labels used were large and prominently placed on the cans, it is possible that participants ignored them. Finally, a fixed amount of money ($6.00) was used for all participants instead of a varied amount, because the purpose of the study did not involve examining variations in individual income; however, this may have influenced food and beverage purchasing.19

**IMPLICATIONS FOR RESEARCH AND PRACTICE**

The growing popularity of EDs among adolescents and young adults has necessitated research on factors that influence ED purchasing and consumption. This study examined 2 such factors: ED price and ED labels. These data suggest that ED consumers are sensitive to price and that adolescent ED consumers are sensitive to caffeine content and warning labels. Taken together, this study showed that regardless of age, ED purchasers are sensitive to price, and that ED labels had an impact on younger consumers but not adults. These data have implications for potential regulations that may discourage ED purchasing, especially among adolescents. Future studies need to examine other age groups as well as include a sample of occasional ED consumers. This report provides a foundation upon which to build these future studies.

**ACKNOWLEDGMENTS**

JLT and AMZ were supported with funds from National Institute on Drug Abuse Grant R01 DA030386. This study was supported by funds from the University at Buffalo and the School of Public Health and Health Professions.
REFERENCES


CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.