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Price and maternal obesity influence purchasing of low- and high-energy-dense foods[2]

Leonard H Epstein, **Kelly K Dearing**, **Rocco A Paluch**, **James N Roemmich**, and **David Cho**
From the University at Buffalo, Department of Pediatrics, Division of Behavioral Medicine, School of Medicine and Biomedical Sciences, Buffalo, NY (LHE, KKD, RAP, and JNR), and the University at Buffalo, Department of Managerial Economics, School of Management, Buffalo, NY (DC)

Abstract

Background— Price can influence food purchases, which can influence consumption. Limited laboratory research has assessed the effect of price changes on food purchases, and no research on individual differences that may interact with price to influence purchases exists.

Objective— We aimed to assess the influence of price changes of low-energy-density (LED) and high-energy-density (HED) foods on mother's food purchases in a laboratory food-purchasing analogue.

Design— Mothers were randomly assigned to price conditions in which the price of either LED or HED foods was manipulated from 75% to 125% of the reference purchase price, whereas the price of the alternative foods was kept at the reference value. Mothers completed purchases for 2 income levels ($15 or $30 per family member).

Results— Purchases were reduced when prices of LED ($P < 0.01$) and HED ($P < 0.001$) foods were increased. Maternal BMI interacted with price to influence purchases of HED foods when the price of HED foods increased ($P = 0.016$) and interacted with price to influence purchases of LED foods when the price of HED foods increased ($P = 0.008$).

Conclusion— These results show the relevance of considering price change as a way to influence food purchases of LED compared with HED foods and the possibility that individual differences may influence the own-price elasticity of HED foods and substitution of LED for HED foods.

Keywords

Price; purchases; energy density; behavioral economics; obesity

INTRODUCTION

The energy density of the diet is an important determinant of total energy intake. Research has shown lower energy intake with a low-energy-density (LED) diet than with a high-energy-density (HED) diet (1–3) and providing LED foods can be an important complement to obesity treatment (4). One factor that may influence the purchase, and thus consumption, of LED or HED foods is price (5,6). Several studies have shown that manipulating price in vending machines (7,8), cafeterias (9–11), and restaurants (12) influences purchases. Purchases of less healthy HED foods is reduced as their price is increased, and purchases of healthier LED foods is increased as their price is reduced. These changes represent examples of own-price elasticity,

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Address reprint requests to LH Epstein, Department of Pediatrics, School of Medicine and Biomedical Sciences, State University of New York at Buffalo, Farber Hall, Room G56, 3435 Main Street, Building #26, Buffalo, NY 14214-3000. E-mail: lhenet@acsu.buffalo.edu..

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which refers to the percentage changes in price for given percentage changes in demand for a food (13). Another possible result of increases in the price of HED foods is a substitution or increase in purchases of LED foods, which is an example of cross-price elasticity. An ideal situation would be that as the price of a class of HED foods increases, purchases of HED foods are reduced and are substituted by purchases of healthy LED foods.

One variable that may influence sensitivity to price changes in HED or LED foods is obesity. Obese persons find food more reinforcing than do lean persons (14), which means that they are more motivated to obtain food and may be less sensitive to price increases for their preferred foods (14). A behavioral analogue in behavioral economic theory to price is response effort (15), and it may be that persons who work harder to gain access to specific types of foods will also pay a greater price for those foods than do persons who do not find food that reinforcing. Another variable may be the amount of money allocated to food purchases. In general, there is an inverse relation between the amount of money that can be spent on food and demand elasticity, with those with lower education and income being more sensitive to price increases (16). Experimental research has shown that reducing available resources will increase substitution of less preferred alternatives when the price of preferred alternatives increases (13,17).

The present study tests the influence of price changes on mother's purchases of HED and LED foods for their families through the use of a laboratory analogue method. Mothers are generally responsible for the quality and quantity of the foods that are brought into the household, which in turn affect the family's eating habits. Modifying the purchasing patterns of mothers can affect the entire family and can aid in the treatment and prevention of pediatric obesity. Laboratory paradigms are often used to determine factors that influence consumer behavior (18,19), and we have used laboratory paradigms to assess the influence of income and price on youth purchases of snack foods (13) and the similarity of parent and child purchases of food (20). Laboratory analogues are particularly useful when doing exploratory research on new paradigms and provide the opportunity to study individual difference variables, which may be more challenging when examining price effects on purchases in the natural environment.

SUBJECTS AND METHODS

Participants

Participants were 47 mothers between the ages of 25 and 50 y. Participants were recruited from an existing family database, through flyers posted around the University of Buffalo campuses, and through direct mailings. Interested participants were screened by telephone to ensure that they met the following study criteria: *1*) had at least one child between the ages of 2 and 15 y of age residing in the household and *2*) were responsible for the primary grocery shopping for the family. Participants were scheduled for a single visit to the laboratory lasting ≈2 h and were asked not to eat for ≥3 h before the appointment. Research suggests that recent eating may influence food purchasing, with more overweight persons purchasing more food after eating than less overweight persons (21–23). Families were recruited over a wide educational and income range. As noted in Table 1, 19.2% of the sample had family incomes below $29,999, and 23.4% had family incomes greater than $70,000. Similarly, 53.2% of the families had a high school, vocational school, or associates degree, whereas 46.8% had a college or graduate degree. The study was approved by the University of Buffalo Social and Behavioral Sciences Institutional Review Board, and participant families received a $25 gift certificate to their choice of a local supermarket chain for completing the study.

Procedures

On their arrival at the laboratory, the participants read and signed consent forms and completed a demographic questionnaire and same-day food recall and hunger questionnaires. The participants rated their liking of the foods used in the experiment on 7-point Likert scales and the frequency at which they purchased the experimental foods. The participants then engaged in the food-purchasing tasks.

The design was a 3-factor design, with 1 between factor and 2 within factors. The between factor was price change condition. The participants were randomly assigned to 2 price change conditions. In one condition, the prices of LED foods varied from ≈25% above and below the reference values while the prices of HED foods remained constant at the reference values. In the other condition, the prices of HED foods varied from ≈25% above and below the reference values while the prices of LED foods remained constant at the reference values.

The within-subject factors were study income and price manipulation. Mothers in each group completed 3 trials that varied price (75%, 100%, and 125% of reference price) for each of 2 income conditions ($15/person and $30/person) in a counterbalanced order. This provided the opportunity to assess whether price had a differential influence on purchases based on available resources. The incomes studied were based on values that were equally lower or higher than a reference value of approximately $22.50, which was computed based on the minimum amount of money that would be needed to eat a balanced diet for the LED foods offered for purchase in this experiment.

Behavioral choice task

The experimental room was set up like a grocery store; cards with pictures of 60 foods were arranged in sections according to food category (eg, bread, produce, meat, etc). On the reverse side of each picture card was nutritional information, and beside each picture card was a set of price cards. Price cards were color coded to indicate whether an item was reduced, at the reference price, or higher than the reference price. Before the start of each trial, the experimenter set the prices for each of the individual food items. The order of the income manipulations was counterbalanced, and the price manipulations were randomized.

During the choice task, the participants were told to imagine that they had no food in their house and the money that they were given was to be used to purchase groceries for their family for the week. During the trial, the participants indicated a purchase by giving the experimenter a picture of the food (there were multiple pictures of each food, so that participants could purchase more than one of an item). The experimenter recorded the amount of each item purchased and let the participant know how much they had left to spend. If the participant had spent too much money, she was asked to put back some of the food items until the total was at or less than the money allotted for that trial. To encourage the participants to spend all of the money, they were told that the food did not have to be consumed in a week and that items could be stored or frozen for later use. In addition, because of the limited selection of brands, the participants were told to purchase food products according to similarity to what they would normally buy.

The foods were sixty foods equally divided into 6 food groups (fruit, vegetables, dairy, protein, grains, and other, which were desserts). Five foods in each group were classified as having low or high energy density, respectively. LED foods had an energy density <2.0 kcal/g, and HED foods had an energy density ≥2.0 kcal/g. Energy density is based on the package information, so if the food is a processed food, the energy density is based on the prepared food; if the food is raw, as in fruit, vegetables, chicken, rice, noodles, etc, the energy density is based on the unprepared food. The energy density may change according to the method of food preparation.

The reference price of each food was determined by the averaged current cost of that food at the 2 largest local supermarkets. Energy density, reference prices, and cost to purchase 100 kcal of the average energy density, reference price, and price per 100 kcal of the foods in that food group are shown in Table 2, and the specific foods studied are shown in Table 3. The cost per 100 kcal of HED versus LED foods was lower for each food group, with value differences ranging from $0.18 compared with $0.28 for HED versus LED breads (156% increase) to $0.28 compared with $2.70 (964% increase) per 100 kcal of HED versus LED vegetables. After the participants completed all trials, their height and weight were measured and they were given a debriefing form.

Measurement

Food liking—The participants' liking of 60 experimental foods was assessed by use of a 7-point Likert scale anchored by 1 (do not like) and 7 (like a lot).

Same-day food recall—The participants were interviewed by the experimenter to ensure that they had not eaten in the 3 h before the appointment.

Hunger—Hunger was assessed by using a 5-point Likert-type scale anchored by "extremely hungry" and "extremely full."

Demographics—The Hollingshead (24) demographics questionnaire was used to assess socioeconomic status on the basis of education level, occupation, and race. Additional information was asked regarding household composition (number of adults and children residing in the primary household) and the approximate amount that was spent on groceries per week.

Height and weight—The participants' weight and height were measured by using a digital scale (TANITA Corporation of America Inc, Arlington Heights, IL) and a digital stadiometer (Measurement Concepts & Quick Medical, North Bend, WA). On the basis of the height and weight data, body mass index (BMI) was calculated according to the following formula: BMI = kg/m^2. Parents were considered obese if they had a BMI ≥ 30 (25).

Analytic plan

Separate mixed-effect regression models (26) with random intercept and fixed effects were used to assess own-price and cross-price elasticity for purchases of HED or LED foods. Mixed-effects regression models are used when the dependent measure is repeated, and these models incorporate individual level heterogeneity. Ordinary least-squares regression cannot be used for these models because the dependent measure is a repeated measure that is collected over different experimental conditions. Log values of the purchases and food prices were used in the regression models, and purchases were adjusted for family size by calculating the total number of LED and HED foods and dividing this total by the number of family members. Because one mother had 0 purchases for HED foods and there is no log of 0, 1 was added to the total adjusted purchases of HED and LED items for all subjects before calculating log values (27). Other models were tested by using smaller values to add to HED and LED purchases; this did not change the significance of the own-price or cross-price elasticity coefficients, but using smaller values increased the degree of elasticity. For example, adding 0.01 rather than 1 increased own-price elasticity from −1.586 to −2.967. Additional factors of weekly amount spent on groceries, number of persons in the family, socioeconomic status, BMI, hunger, age, and minority status were added to the models. Separate regression models were run for own-price and cross-price elasticity for purchases of LED and HED foods. An example of the equation to predict own-price and cross-price elasticity for LED foods is as follows

$$\begin{aligned}\text{Ln purchases} &= \alpha + \beta_1(\ln \text{LED price}) \\ &+\beta_2(\ln\ \text{HED price}) + \beta_3(\text{study income}) \\ &+\beta_4(\text{BMI}) + \beta_5(\text{prehunger}) + \beta_6(\text{age}) \\ &+\beta_7(\text{usual spending on groceries}/\text{wk}) \\ &+\beta_8(\text{number of persons in the home}) \\ &+\beta_9(\text{socioeconomic status}) \\ &+\beta_{10}[(\ln\ \text{HED price}) \times \text{BMI}] \\ &+\beta_{11}[(\ln\ \text{LED price}) \times \text{BMI}]\end{aligned} \quad (1)$$

The regression coefficients of logged prices represent the price elasticities of demand. Specifically, the coefficient of logged LED price is the own-price elasticity of LED food and that of logged HED price is the cross-price elasticity of LED foods with respect to HED foods. For example, an own-price elasticity coefficient of −2.0 means that if its price increases by 10%, the demand decreases by 20% (−2 × 10%). Positive cross-price elasticity coefficients imply that the products are substitutes (eg, as the price of a commodity increases, the purchases of an alternative commodity with a stable price increases), whereas negative cross-price elasticity coefficients imply that the products are complements. Data were analyzed by using SYSTAT (28).

RESULTS

The regression models are summarized in Table 4 and are presented in Figure 1. The estimates for own-price elasticity were significant for purchases of LED (coefficient = −0.569, $P < 0.01$, Figure 1A) and HED (coefficient = −1.586, $P < 0.001$, Figure 1B) foods. Cross-price elasticity was significant for purchases of LED foods when the price of HED foods increased (coefficient = 0.622, $P = 0.001$, Figure 1C), but was not significant for HED foods with respect to LED prices. A cross-price elasticity of 0.622 means that when HED prices are increased by 10%, the demand for LED foods increases by 6.22%. Own-price elasticity for HED foods differed on the basis of BMI as evidenced by the significant interaction between the price of HED foods and BMI (coefficient = 0.023, $P = 0.016$). Cross-price elasticity for LED foods was also related to BMI, as evidenced by the significant interaction between the price of HED foods and BMI (coefficient = −0.017, $P = 0.008$). Hunger was a significant predictor of purchases of both LED (coefficient = −0.041, $P = 0.008$) and HED (coefficient = 0.060, $P = 0.005$) foods. Hungrier mothers purchased more HED and less LED foods. The amount of money available for food purchases per family member ($15/$30) was also a significant predictor of purchases of both LED (coefficient = 0.032, $P < 0.001$) and HED (coefficient = 0.046, $P < 0.001$) foods: the greater the amount of money, the more purchases that were made. No significant interactions of age, hunger, amount spent on groceries, number of family members, socioeconomic status, or minority status with price were observed.

The interactions of BMI by own- and cross-price elasticity were further explored in separate regression models to estimate own-price elasticity for nonobese (BMI < 30) and obese (BMI ≥ 30) mothers (Table 5). The own-price elasticity of HED foods for the nonobese and obese mothers was −1.051 ($P < 0.001$) and −0.767 ($P < 0.001$), respectively, with the nonobese mothers being more sensitive to increases in the price of HED foods than were the obese mothers. Furthermore, nonobese mothers were more likely to substitute LED foods for HED foods when the price of HED foods increased than were obese mothers. The cross-price elasticity of LED foods with respect to HED foods was 0.219 ($P = 0.001$) for nonobese and −0.025 ($P = 0.777$) for obese mothers. The relation between obesity and the cross-price elasticity of LED foods with respect to HED foods is also shown in Figure 2. The purchases of LED foods increased as the price of HED foods increased for the nonobese mothers, whereas the purchases of LED foods did not reliably change with changes in the price of HED foods for obese mothers.

Because the cost per 100 kcal is less for HED foods than for LED foods, mothers purchased more energy from the HED foods than from the LED foods at each price comparison. For example, according to the average energy for foods purchased in the LED and HED food groups, mothers in the $30.00 per family member condition purchased 8309.9 kcal of HED foods but only 5116.7 kcal of LED foods when the price of these foods was reduced to 75% of the reference price, and 4701.1 kcal of HED foods compared with 3222.6 kcal of LED foods when the price of these foods was 125% of the reference price. When the price of HED foods increased, there was an increase in purchases of LED foods. For example, mothers in the $30.00 per family member condition purchased 4028.0 kcal of LED foods when the price of HED foods was 75% of the reference price, and 4350.3 kcal of LED foods when the price of HED foods was 125% of the reference price.

DISCUSSION

These results show the expected own-price elasticity for HED and LED foods, ie, as the price goes up, purchases go down. These data along with other laboratory (13,29) and field research (7–12) suggest that one way to increase the purchase of healthy foods is to reduce the price of these foods. Conversely, purchases of less healthy foods will decrease as their price increases.

Perhaps a more interesting observation is that there is an increase in purchases of LED foods as the price of HED foods increases for leaner mothers but not for obese mothers. In addition, leaner mothers are more sensitive to price changes in HED foods. This represents an ideal situation for leaner mothers, in that increasing the price of HED foods not only reduces their purchases of HED foods, but also increases their purchase of LED foods. The usual rationale for public health policy approaches that increase the price of less healthy foods is that these policy changes can contribute to preventing or reducing obesity, but such approaches are usually not targeted at leaner, perhaps more health conscious mothers. To our knowledge, this is the first observation that cross-price elasticity is related to body weight, and this result suggests that leaner mothers may be more likely to shift purchasing from HED to LED foods on the basis of price changes of HED foods. Because food consumption at home is based in part on foods stored at home, this finding may have important implications for understanding factors that may influence the development of obesity. However, the observation that obese mothers may be less likely to either reduce purchases of HED foods when their price increases or to purchase more LED foods when the price of HED foods increase may reduce the utility of any economic approach that uses increases in prices of less healthy foods to reduce their consumption.

The price was increased or decreased by 25%, which is consistent with changes in prices for fresh foods (30). Although significant changes in purchasing were observed, prices in other experimental research have been greater, with changes in price of up to 50% (13,29,31). The amount of change in price that is needed to influence purchasing may differ for different types of foods, and research is needed to establish the price elasticity for different types of foods. The price elasticity of fruit and vegetables is higher than that for snack foods such as potato chips (32–34), which suggests that at the same percentage price change, there may be a bigger effect on health by reducing prices of healthy foods by subsidies than by increasing prices of less healthy foods. Kuchler et al (32) argue that the low price elasticity of snack foods suggests that increasing their price would have a minimal effect on intake, although the taxes would generate revenue for nutrition education.

One idea for using taxes to increase prices of less healthy foods is that taxes may generate revenue that can be used to subsidize lower prices for healthier foods, as well as generate funds for nutrition education (5,32). One potential limitation in the use of taxes is that they will have different influences on obese and lean persons, with the potential for less influence on obese or less health conscious persons than on leaner and more health conscious persons (35,36). Our study shows that increasing the price of less healthy food may have benefits for the leaner, perhaps more health conscious mothers on purchasing healthier substitutes, but may not have the desired effect for the obese mothers. Obese mothers were less price sensitive than the nonobese mothers. This implies that price increases for less healthy food will not produce as great a reduction in less healthy foods for obese than for nonobese mothers or will not encourage consumption of healthier food for the obese, which potentially limits the public health utility of these approaches.

The present study provides an initial experimental test of the influence of price changes on purchases of HED or LED foods. In this study, the prices of all LED or HED foods were manipulated as an energy density group at the same time, and we observed that the elasticity of HED foods was greater than that for LED foods, which may be a function of shifting the prices of all LED foods rather than of specific LED foods. The utility of public policy changes for shifting consumption on the basis of taxes or subsidies may depend in part on how broadly the taxes are implemented. This is an important factor, because one potential limitation of changing prices on select foods within energy density groupings is that persons will substitute other less healthy foods for the ones that have an increased price. For example, increasing the price of soft drinks may shift purchase to sweetened fruit juice drinks.

One factor that may influence food purchasing and shed light on the differences in substitution of LED for HED foods in obese and nonobese mothers is the relative reinforcing value of food. Obese women will work harder than nonobese women for food (14), and this increase in motivation to obtain food may be related to differences in purchasing food. We have shown that LED foods can substitute for HED foods in nonoverweight college students, as shown by increases in responding for LED foods when the behavioral cost of obtaining HED foods is increased (37). Behavioral economics assumes that price or behavioral cost are similar ways to influence behavior, and experiments that manipulate behavioral access may provide insight into public policy involving price (38). It is thus possible that the reinforcing value of food, which influences the motivation to work for food, also influences purchases of food.

One reason for the lower sensitivity of obese mothers to price changes is the possibility that they were attempting to purchase more calories to maintain their greater body weight than were the nonobese mothers. As noted by Drewnowski and Darmon (39), people can save money by choosing higher-energy-dense foods, which have a cheaper energy cost than do lower-energy-dense foods. If the goal is for the obese mother to maintain her weight, then she may be less sensitive to price increases in higher-energy-dense foods. On the other hand, a public health goal might be for obese persons to reduce their energy consumption to reduce adiposity, and obese mothers who are interested in losing weight may be more sensitive to price changes than are obese persons who are not motivated to reduce their body weight. Future studies should examine whether obese persons differ in their price sensitivity as a function of their motivation for weight loss.

This study used an experimental laboratory analogue to evaluate the effect of price on food purchases. Experimental laboratory research emphasizes internal validity, and experimental methods can provide a strong test of theory. The strengths of experimental methods are balanced by the concern about external validity (40). Laboratory analogues and simulations are often used to determine factors that influence consumer behavior (41). Laboratory simulations are often preferred to large-scale studies in the natural environment because of the high degree of control provided and the ability to collect large amounts of data inexpensively (42). In a study by Burke et al (43), actual supermarket purchases over 7 mo were compared with purchases made in 2 laboratory simulation tasks. The first laboratory simulation was a rudimentary laboratory with the experimenter providing a verbal description of the available brands; the second laboratory simulation involved a computer simulation, much like an online grocery store. Results showed high correlations between real purchasing and purchasing in the laboratory in response to price specials. Similar studies have shown a relation between purchases in the natural environment and purchases in the laboratory (44), and laboratory experiments have been used to calculate demand elasticities for various brand name products (42).

The laboratory procedures used in the current study may have limitations. The participants were encouraged to spend all their money during each trial or trip to the grocery store. Outside of the laboratory, people may want to save money when there are sales on usual purchases and may allocate money to other types of expenses. In the laboratory purchasing paradigm, trial length is relatively constant across trials, whereas in usual shopping, the duration of a shopping episode may be compressed because of other demands or may be extended to socialize, have coffee, eat, or sample new foods. The closer the simulation is to the usual shopping experience, the greater the potential for external validity. Another factor that may be important is that in this laboratory study, the subjects used money provided by the experimenter, so there was no penalty to the participant for spending more than they usually would shopping. One solution to this problem would be to ask the participants to use their own money in the laboratory environment (45).

In summary, the results of the present study suggest that basic economic principles can be studied in the laboratory and that important individual differences may exist in how LED foods can substitute for HED foods when the cost of the HED foods increases. Research is needed to assess whether individual differences in response to price changes can be modified.

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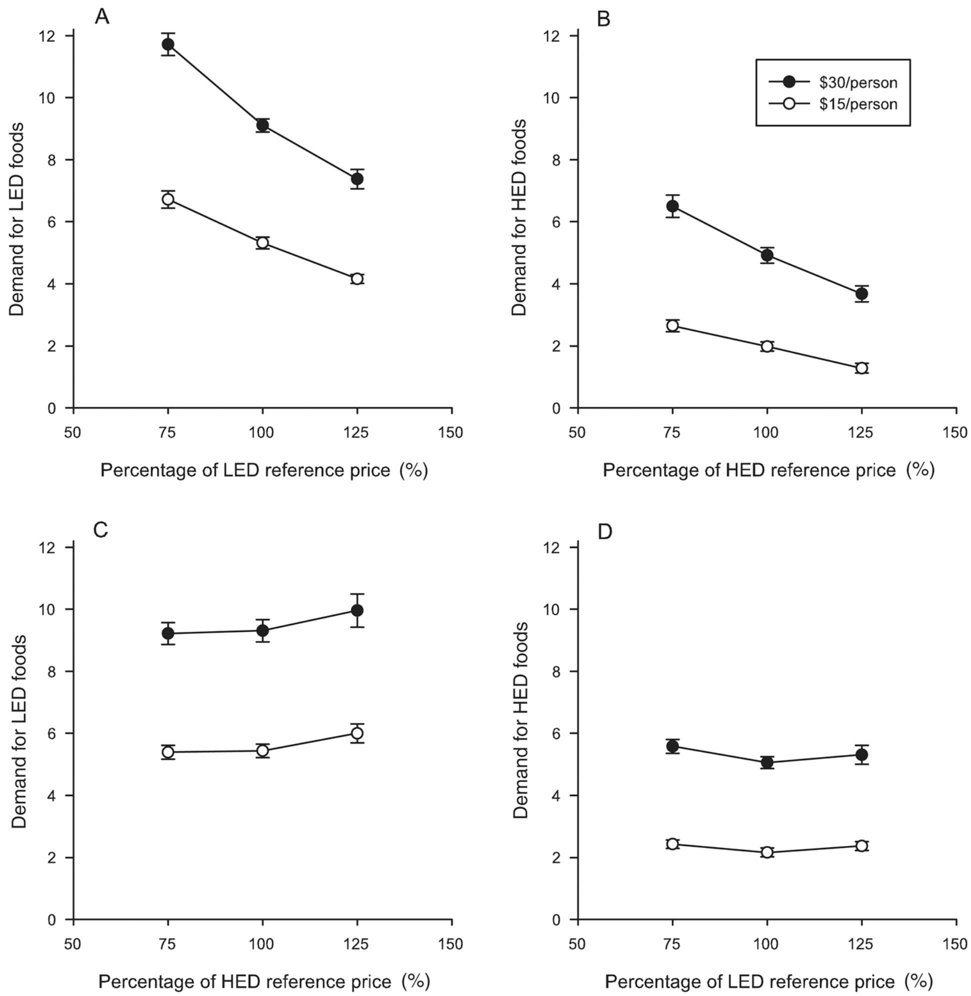

FIGURE 1.

Mean (± SEM) number of items purchased by mothers of low energy dense (LED) and high energy dense (HED) foods in relation to price and income ($30 or $15 per family member). Purchases of the types of foods for which prices are changed are shown in panels A and B, whereas purchases of the alternative types of foods are shown in panels C and D. The estimates for own-price (estimate = −0.569, $P < 0.01$) and cross-price (estimate = 0.622, $P = 0.001$) elasticity for LED foods were significant, as was own-price elasticity for HED foods (estimate = −1.586, $P < 0.001$). There were no significant interactions with income for own-price (estimate = −0.005, $P > 0.05$) or cross-price (estimate = −0.003, $P > 0.05$) elasticity for LED foods or own-price (estimate = −0.001, $P > 0.05$) or cross-price (estimate = −0.003, $P > 0.05$) elasticity for HED foods, respectively.

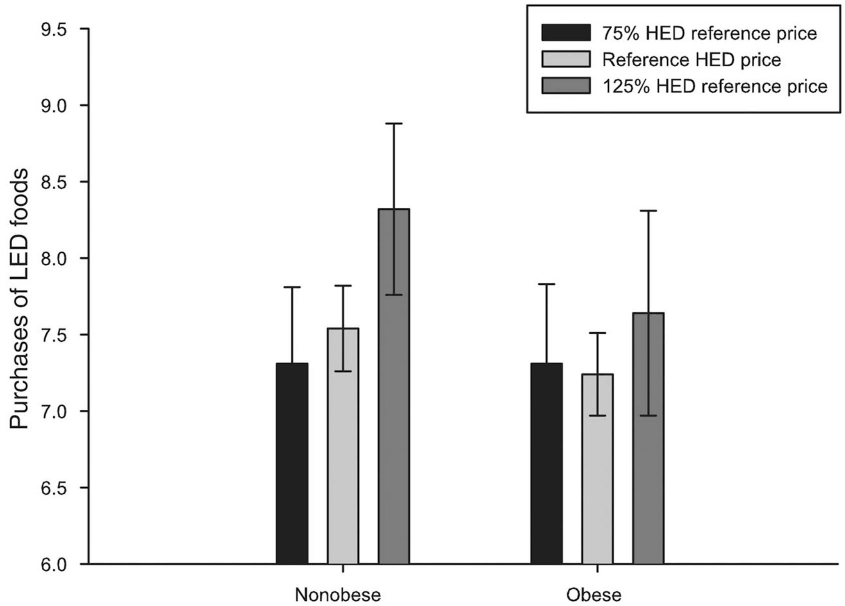

FIGURE 2.
Mean (± SEM) number of purchases of low energy dense (LED) foods when the price of high energy dense (HED) foods was changed in nonobese (BMI < 30; n = 30) and obese (BMI ≥ 30; n = 17) women. Cross-price elasticity for LED foods for obese mothers was significant (estimate = 0.219, P < 0.001).

TABLE 1

Subject characteristics

Characteristic	Value
Age (y)	39.9 ± 5.5[1]
BMI (kg/m^2)	28.1 ± 7.1
Amount spent per week on groceries ($)	108.0 ± 43.3
Number of people in the family (*n*)	4.1 ± 1.2
Hunger rating[2]	2.4 ± 0.8
Liking of HED foods[3]	4.5 ± 0.6
Liking of LED foods[3]	5.0 ± 0.6
Socioeconomic status	44.9 ± 14.3
Household income [*n* (%)]	
< $29,999	9 (19.2)
$30,000–$69,999	27 (57.5)
≥ $70,000	11 (23.4)
Highest level of education completed	
High school, vocational training, or associates degree	25 (53.2)
College degree or graduate degree	22 (46.8)
Race/ethnicity	
White	34 (72.3)
Minority (Hispanic, African American)	10 (21.3)
Other or multirace	3 (6.4)
Obesity	
Nonobese (BMI < 30)	30 (63.8)
Obese (BMI ≥ 30)	17 (36.2)

[1] $\bar{x}$ ± SD (all such values).

[2] Assessed on a 5-point Likert-type scale.

[3] Assessed on a 7-point Likert scale.

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TABLE 2

Energy density, price, and cost per 100 kcal of low energy density (LED) and high energy density (HED) foods in the 6 food groups studied[1]

Food category	LED foods			HED foods		
	Energy density	Reference price	Cost per 100 kcal	Energy density	Reference price	Cost per 100 kcal
		$	*$*		*$*	*$*
Fruit						
Average	0.64	1.20	0.46	3.57	1.98	0.24
Range	0.49–0.89	0.44–1.64	0.11–0.58	2.5–5.25	1.65–2.49	0.08–0.50
Vegetables						
Average	0.34	2.36	2.70	3.26	2.65	0.28
Range	0.14–0.70	1.49–2.99	0.93–7.43	2.00–6.43	2.00–3.49	0.12–0.51
Dairy						
Average	0.90	2.32	0.52	3.03	3.13	0.29
Range	0.40–1.50	1.67–3.00	0.10–0.69	2.15–3.81	2.49–3.79	0.14–0.60
Protein						
Average	1.23	1.88	0.68	2.81	2.60	0.28
Range	1.05–1.55	0.62–3.74	0.06–1.09	2.40–3.18	1.50–3.49	0.10–0.58
Snacks						
Average	0.85	2.39	0.50	4.81	2.45	0.17
Range	0.59–1.27	1.66–3.42	0.32–0.95	3.14–5.71	2.00–2.99	0.12–0.25
Breads						
Average	1.24	1.47	0.28	3.27	2.58	0.18
Range	1.12–1.33	0.79–1.89	0.12–0.38	2.58–3.75	1.99–3.49	0.13–0.21

[1] Reference price is based on recent prices at local grocery stores.

TABLE 3

Energy density and reference price of the low energy density (LED) and high energy density (HED) foods studied

Food (amount)	Energy density	Price[1]
LED foods		$
Apple (453.6 g)	0.52	1.24
Grapes (453.6 g)	0.69	1.64
Bananas (453.6 g)	0.89	0.44
Pears (453.6 g)	0.58	1.39
Oranges (453.6 g)	0.49	1.29
Baby carrots (907.2 g)	0.35	2.99
Bag of lettuce (255.1 g)	0.14	2.60
White potatoes (2.27 kg)	0.70	2.49
Cherry tomatoes (0.473 L)	0.18	2.25
Broccoli (453.6 g)	0.34	1.49
Skim milk (3.79 L)	0.40	1.67
Nonfat yogurt (4/170.1 g containers)	0.47	2.20
Nonfat cottage cheese (453.6 g)	0.69	1.74
Nonfat American cheese (340.2 g sliced)	1.43	3.00
Nonfat Cheddar cheese (340.2 g sliced)	1.50	3.00
Eggs (dozen)	1.43	0.62
Lean chicken (453.6 g)	1.55	3.74
Turkey luncheon meat (170.1 g sliced)	1.05	1.95
Chicken breast luncheon meat (170.1 g sliced)	1.05	1.89
Tuna canned in water (170.1 g)	1.07	1.20
Mixed fruit cup (4/113.4 g containers)	0.62	1.66
Fat-free chocolate pudding (6/113.4 g containers)	0.88	2.00
Applesauce (6/113.4 g containers)	0.88	1.89
100%–Fruit juice bars (12 51g bars)	0.59	3.42
Fudgesicle (10 71 g bars)	1.27	3.00
Brown rice (396.9 g)	1.12	1.69
White rice (447.9 g)	1.29	1.69
Pasta (453.6 g)	1.24	0.79
Couscous (164.4 g)	1.24	1.89
Egg noodles (340.2 g)	1.33	1.29
HED foods		
Vanilla yogurt raisins (226.8 g)	4.33	1.99
Dried apricots (198.4 g)	2.50	2.49
Dried prunes (340.2 g oz)	2.50	1.99
Banana chips (453.6 g)	5.25	1.79
Raisins (6 42.5 g packs)	3.25	1.65
French fries (567 g)	2.50	2.00
Sun-dried tomatoes (212.6 g)	3.21	2.49
Tater tots (850.5 g)	2.18	2.29
Fried onions (170.1 g)	6.43	2.99
Guacamole dip (340.2 g)	2.00	3.49
String cheese (12 28.4 g sticks)	2.86	2.99
Cream cheese (453.6 g)	3.33	2.49
Mozzarella cheese (453.6 g)	3.0	3.79
Processed cheese (340.2 g)	3.81	3.59
Vanilla ice cream (1036 g)	2.15	2.79
Chicken nuggets (340.2 g)	3.18	2.55
Hot dogs (453.6 g)	2.57	3.49
Bologna (453.6 g)	3.21	1.50
Sausage (453.6 g)	2.70	2.49
Fish sticks (215.5 g)	2.40	3.00
Potato chips (340.2 g)	5.36	2.25
Chocolate chip cookies (425.2 g)	4.85	2.50
Cheddar cheese popcorn (255.1 g)	5.71	2.99
Fruit snacks (10 25.5 g pouches)	3.14	2.00
Tortilla chips (368.5 g)	5.0	2.50
Pop tarts (396.9 g)	3.67	1.99
Froot Loops cereal (377 g)[2]	3.75	2.98
Wheat bread (453.6 g)	2.67	2.24
Plain bagels (6 81 g bagels)	2.58	2.19
Corn Chex cereal (442.3 g)[3]	3.67	3.49

[1] Price is based on recent prices at local grocery stores.

[2] Kellogg's, Battle Creek, MI.

[3] General Mills, Golden Valley, MN.

TABLE 4

Summary of results of the regression analysis for purchases of low energy density (LED) and high energy density (HED) foods

	LED foods			HED foods		
Variable	**Estimate**	**SE**	***P***	**Estimate**	**SE**	***P***
Constant	1.030	1.349	0.445	8.273	1.945	< 0.001
Own-price elasticity	−0.569	0.220	< 0.010	−1.586	0.275	< 0.001
Cross-price elasticity	0.622	0.191	0.001	−0.058	0.317	0.856
Study income	0.032	0.001	< 0.001	0.046	0.001	< 0.001
Age	0.004	0.003	0.121	−0.007	0.003	0.035
Hunger	−0.041	0.016	0.008	0.060	0.021	0.005
BMI	0.119	0.046	0.011	−0.106	0.067	0.112
Amount spent on groceries/wk	0.001	0.0004	0.014	−0.003	0.001	< 0.001
No. of family members	−0.069	0.013	< 0.001	0.120	0.018	< 0.001
Socioeconomic status	0.003	0.001	0.007	−0.004	0.001	0.011
Minority status	0.037	0.030	0.224	−0.003	0.041	0.944
Cross-price elasticity × BMI	−0.017	0.007	0.008	−0.001	0.011	0.928
Own-price elasticity × BMI	−0.008	0.008	0.316	0.023	0.009	0.016

TABLE 5

Summary of results of the regression analysis for purchases of low energy density (LED) and high energy density (HED) foods for nonobese (n = 30) and obese (n = 17) mothers

	LED foods			HED foods		
Variable	**Estimate**	**SE**	***P***	**Estimate**	**SE**	***P***
Nonobese mothers						
Constant	3.929	0.427	< 0.001	5.532	0.640	< 0.001
Own-price elasticity	−0.754	0.058	< 0.001	−1.051	0.098	< 0.001
Cross-price elasticity	0.219	0.064	< 0.001	−0.072	0.089	0.418
Study income	0.032	0.001	< 0.001	0.046	0.002	< 0.001
Age	0.003	0.003	0.269	−0.006	0.004	0.086
Hunger	−0.027	0.021	0.188	0.046	0.026	0.081
Amount spent on groceries/wk	0.001	0.0006	0.080	−0.003	0.001	< 0.001
No. of family members	−0.108	0.022	< 0.001	0.167	0.027	< 0.001
Socioeconomic status	0.003	0.001	0.010	−0.004	0.002	0.028
Minority status	0.032	0.041	0.433	−0.010	0.052	0.847
Obese mothers						
Constant	5.272	0.577	< 0.001	4.615	0.774	< 0.001
Own-price elasticity	−0.833	0.080	< 0.001	−0.767	0.112	< 0.001
Cross-price elasticity	−0.025	0.087	0.777	−0.118	0.102	0.249
Study income	0.032	0.002	< 0.001	0.045	0.002	< 0.001
Age	0.003	0.004	0.386	−0.006	0.007	0.400
Hunger	−0.071	0.019	< 0.001	0.099	0.034	0.003
Amount spent on groceries/wk	0.001	0.0005	0.020	−0.003	0.001	< 0.002
Number of family members	−0.038	0.013	0.004	0.082	0.024	< 0.001
Socioeconomic status	0.003	0.001	0.021	−0.005	0.002	0.048
Minority status	0.051	0.039	0.182	−0.011	0.069	0.871