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Experimental analysis of the effect of taxes and subsides on calories purchased in an on-line supermarket

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ABSTRACT

Taxes and subsidies are a public health approach to improving nutrient quality of food purchases. While taxes or subsidies influence purchasing, it is unclear whether they influence total energy or overall diet quality of foods purchased. Using a within subjects design, selected low nutrient dense foods (e.g. sweetened beverages, candy, salty snacks) were taxed, and fruits and vegetables and bottled water were subsidized by 12.5% or 25% in comparison to a usual price condition for 199 female shoppers in an experimental store. Results showed taxes reduced calories purchased of taxed foods (coefficient = −6.61, CI = −11.94 to −1.28) and subsidies increased calories purchased of subsidized foods (coefficient = 13.74, CI = 8.51 to 18.97). However, no overall effect was observed on total calories purchased. Both taxes and subsidies were associated with a reduction in calories purchased for grains (taxes: coefficient = −6.58, CI = −11.91 to −1.24, subsidies: coefficient = −12.86, CI = −18.08 to −7.63) and subsidies were associated with a reduction in calories purchased for miscellaneous foods (coefficient = −7.40, CI = −12.62 to −2.17) (mostly fats, oils and sugars). Subsidies improved the nutrient quality of foods purchased (coefficient = 0.14, CI = 0.07 to 0.21). These results suggest that taxes and subsidies can influence energy purchased for products taxed or subsidized, but not total energy purchased. However, the improvement in nutrient quality with subsidies indicates that pricing can shift nutritional quality of foods purchased. Research is needed to evaluate if differential pricing strategies based on nutrient quality are associated with reduction in calories and improvement in nutrient quality of foods purchased.

Using price changes is a public health approach to modify food purchasing (Finkelstein, Strombotne, Zhen, & Epstein, 2014; Powell, Chriqui, Khan, Wada, & Chaloupka, 2013; Thow, Downs, & Jan, 2014). Based on the economic law of demand, research has shown that increasing the price of low nutrient density foods will decrease purchases of those foods, whereas reducing the price of high nutrient density foods increases their purchases (An, 2013, 2014; Epstein et al., 2012; Faith, Fontaine, Baskin, & Allison, 2007; Jacobson & Brownell, 2000; Kuchler, Tegene, & Harris, 2005; Thow et al., 2014). For this reason, nearly every US state differentially taxes specific types of food, such as soda, candy or chips (Chriqui, Eidson, Bates, Kowalczyk, & Chaloupka, 2008) and some federal programs subsidize healthier foods to increase their consumption.

Taxes on sugar sweetened beverages have been shown to decrease their consumption with limited evidence of substitution to other beverages or non-beverage food categories (Finkelstein et al., 2013; Waterlander, Mhurchu, & Steenhuis, 2014). Yet, these taxes have had limited effects on weight outcomes (Powell et al., 2013; Sturm, Powell, Chriqui, & Chaloupka, 2010). Subsidies on healthy items are less common. The most common food subsidy programs in the United States are funded by the Federal government through the Women, Infant and Children (WIC) Nutrition Program and Supplemental Nutrition Assistance Program (SNAP), both of which are designed to reduce food insecurity (Powell et al., 2013). Subsidies for fruits and vegetables have been shown to

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increase their purchases (Bartlett et al., 2014; French, 2003; Powell, Zhao, & Wang, 2009). WIC allows monthly cash vouchers for fruits and vegetables (Oliveria & Frazao, 2009) and at least two states enacted pilot programs to look at incentivizing purchases of fruits, vegetables and other healthy foods among SNAP recipients (Guthrie, Frazao, Andrews, & Smallwood, 2007). However, the extent to which these strategies improve the nutrient quality of the diet remains unknown.

Decisions about the optimal pricing approach to influence dietary intake should be based on empirical data. Experimental supermarkets provide an approach for testing such strategies (Epstein, Dearing, Roba, & Finkelstein, 2010; Giesen, Havermans, Nederkoorn, & Jansen, 2012; Nederkoorn, Havermans, Giesen, & Jansen, 2011). Research is needed to go beyond analysis of changes in foods taxed or subsidized to assess changes in all foods purchased, as the number of foods that are taxed or subsidized may only be a small subset of foods purchased and people may substitute purchases away from (toward) the taxed (subsidized) foods in efforts to optimize their food budget.

The goal of this study was to assess the effect of taxes and subsidies on changes in total and macronutrient energy and nutrient quality of foods purchased. Energy purchased was assessed given its relationship to obesity, a critical public health issue, and nutrient quality was assessed since it is possible that the quality of foods purchased resulting from a tax or subsidy may improve, even if the number of calories purchased does not significantly change. To provide a more complete assessment of how taxes and subsidies may influence purchasing, we also assess changes in calories purchased for eleven major food categories.

1. Methods and procedures

1.1. Participants

Participants were 199 women, recruited from an existing family database, flyers posted around the University at Buffalo campuses and in the community, web based recruitment (e.g ads on Craig's list and on the department's website) and targeted direct mailings. Inclusion criteria included: females 19 years of age or older and the primary grocery shopper for a household containing at least one child between the ages of 2 and 18, who purchased the majority of their groceries once a week or could adequately purchase their groceries once a week. Weekly purchasing of food was included as an inclusionary criteria since the study design was to compare purchasing across weekly shopping conditions. Additional inclusionary criteria included no dietary restrictions that could interfere with the experiments, including food allergies or religious or ethnic practices that limit food choice; medical conditions that could alter nutritional status or intestinal absorption (eg, inflammatory bowel disease); not currently pregnant; and no psychopathology or developmental disabilities (e.g. attention deficit hyperactivity disorder) that would limit participation. A participant flow chart is shown in Fig. 1. Participants were compensated $290, minus the cost of one week's worth of groceries they selected in the online supermarket, which they received at study completion. Participants were told they would be provided with groceries they purchased from a randomly selected week. This was done to maximize the chance they selected foods they would have purchased for their family. Compensation ranged from $52.09 to $256.88. The study was approved by the University at Buffalo Social and Behavioral Sciences Institutional Review Board.

1.2. Procedures

Participants were studied across six weekly sessions, one assessment session (details of which are reported elsewhere: (Epstein et al., 2014)) and five experimental shopping sessions. Prior to the first session, participants completed questionnaires including a basic demographics form. Participants were asked to refrain from eating or drinking, other than water, for 2 h prior to each session. Upon arrival to the laboratory, participants read and signed consent forms and a study agreement, and they completed a multi-pass same-day food recall to verify adherence to the study protocol.

The five laboratory shopping sessions were scheduled approximately one week apart during which they selected their weekly household groceries under varying price conditions (tax 12.5%, tax 25%, no tax or subsidy, subsidy 12.5%, subsidy 25%). The order of the five shopping sessions (tax, subsidy, none) was counterbalanced and the order of the price manipulations (25, 12.5) within each tax/subsidy condition were randomized. After the completion of the final purchasing session, participant's height and weight were taken, they were debriefed and compensated.

Receipts from all foods purchased during the two weeks prior to starting the study and throughout the duration of the study were collected to compare the amount usually spent for food in the supermarket with amounts spent in the experimental store.

1.3. Online virtual shopping experience

The virtual supermarket, which included approximately 6000 food items, was designed to mimic an online shopping experience. A food item's picture, package size, price, nutritional information based on nutrition facts labels or the USDA website, ingredients, and warnings were presented. The store contained various sizes of a wide range of national and local brand products. For the purposes of searching for foods, items were sorted into major categories representative of a supermarket such as bakery, beverages, meat and dairy, with each category divided into subcategories for easier navigation and shopping (e.g. Meat →Beef, Lamb, Meat Substitutes, Pork, Poultry, Seafood). Participants browsed for foods by clicking on subcategories or using a search bar. On subcategory pages, participants saw a list of products, package sizes and prices. Clicking on a food item displayed a picture of the product as well as the product's price and nutritional information.

Participants added items to their online grocery cart and a running total of purchases was displayed on the right hand side of the screen. Participants were asked to find substitutes for products that they would normally purchase but were not available in the online store. Reference prices in the store were updated every three to four months based on prices from one of the largest grocery retailers in the region.

Price changes of 12.5% and 25% were based on our previous research which showed price increases of 12.5% and 25% resulted in reductions in purchasing of low nutrient density foods and price reductions of 12.5% and 25% resulted in increases in purchasing of high nutrient density foods in a sample of mothers in an experimental shopping task (Epstein et al., 2010). In the subsidy conditions, fruits, vegetables and zero calorie bottled water were discounted by 12.5 and 25% of the reference price. In the tax conditions, prices of all regular soda, soft drinks, sweetened juice drinks, all candy and gum and selected salty snack foods, such as potato chips, corn chips and puffs, were increased by 12.5 and 25% of the reference price. All taxed foods were products that were taxed by states somewhere in the United States of America when the study began. Price changes were indicated to the participant by a slash through the original price and the new price displayed in red (taxes) or green (subsidies). To simulate supermarket circulars, participants were given a newsletter prior