Accepted Manuscript

Price and convenience: The influence of supermarkets on consumption of ultra-processed foods and beverages in Brazil

Priscila Pereira Machado, Rafael Moreira Claro, Daniela Silva Canella, Flávia Mori Sarti, Renata Bertazzi Levy

PII: S0195-6663(17)30400-2

DOI: 10.1016/j.appet.2017.05.027

Reference: APPET 3478

To appear in: *Appetite*

Received Date: 13 March 2017

Revised Date: 25 April 2017

Accepted Date: 15 May 2017

Please cite this article as: Machado P.P., Claro R.M., Canella D.S., Sarti Flá.Mori. & Levy R.B., Price and convenience: The influence of supermarkets on consumption of ultra-processed foods and beverages in Brazil, *Appetite* (2017), doi: 10.1016/j.appet.2017.05.027.

Price and convenience: the influence of supermarkets on consumption of ultra-processed foods and beverages in Brazil

Priscila Pereira Machado[1,2], Rafael Moreira Claro[2,3], Daniela Silva Canella[2,4], Flávia Mori Sarti[1], Renata Bertazzi Levy[2,5]

[1] Faculdade de Saúde Pública da Universidade de São Paulo, Av. Dr. Arnaldo 715, 2° andar, São Paulo, São Paulo 01246-904, Brazil
[2] Núcleo de Pesquisas Epidemiológicas em Nutrição e Saúde (NUPENS/USP), Faculdade de Saúde Pública, Universidade de São Paulo, Av. Dr. Arnaldo, 715, São Paulo, SP 01246-904, Brazil
[3] Escola de Enfermagem, Universidade Federal de Minas Gerais, Av. Professor Alfredo Balena, 190, Belo Horizonte, MG 3013100, Brazil
[4] Instituto de Nutrição, Universidade do Estado do Rio de Janeiro, Av. Carlos Chagas Filho, 373, Rio de Janeiro, RJ 21941902, Brazil
[5] Departamento de Medicina Preventiva, Faculdade de Medicina, Universidade de São Paulo, Av. Dr. Arnaldo, 455, São Paulo, SP 01246903, Brazil

Corresponding author: (P. P. Machado).
Department of Nutrition, School of Public Health, University of São Paulo, Av. Dr. Arnaldo, 715, São Paulo, SP 01246-904, Brazil.
E-mail address: priscilamachado@usp.br

Acknowledgments

Financial support: This research was supported by the São Paulo Research Foundation (FAPESP- grant number 2014/26954-3). PPM received a master's scholarship from the Coordination for the Improvement of Higher Education Personnel (CAPES) and from the São Paulo Research Foundation (FAPESP- grant number 2014/26737-2). CAPES and FAPESP had no role in the design, analysis or writing of this article.

Conflict of Interests: None.

Authorship: PPM and RBL formulated the research question, designed and carried out the study, as well as conducted the data analyses and wrote the article. RMC, DSC and FMS supervised the analyses, as well as giving feedback on the writing. All authors have also read and approved the final version of the manuscript.

Ethical Standards Disclosure: Ethical approval was not required.

Price and convenience: the influence of supermarkets on consumption of ultra-processed foods and beverages in Brazil

Abstract

Objective: To evaluate the influence of convenience and price of ultra-processed foods and beverages on purchases at supermarkets. **Methods:** The study used data on food and beverage acquisition for household consumption from the Brazilian Household Budget Survey, performed in a random sample of 55,970 households between 2008-2009. Foods and beverages were categorized into four groups, according to characteristics of food processing. Retail stores were grouped into supermarkets and other food stores. Proportion of calories from foods and beverages purchased at supermarkets and other food stores, and respective mean prices (R$/1,000 kcal), were calculated according to households' geographical and socioeconomic characteristics. Effect of convenience in household purchases at retail stores was expressed by the acquisition of several food items at the same store. The influence of convenience and prices of ultra-processed products on purchases at supermarkets was analyzed using log-log regression model with estimation of elasticity coefficients. **Results:** The mean prices of foods and beverages purchased at supermarkets were 37% lower in comparison to other food stores. The share of ultra-processed foods and beverages in purchases made at supermarkets was 25% higher than at other food stores. An increase of 1% in prices of ultra-processed food items led to a 0.59% reduction in calorie acquisition at supermarkets (R^2=0.75; $p<0.001$). On the other hand, an increase of 1% in the number of food items purchased at supermarkets resulted in 1.83% increase in calorie acquisition of ultra-processed foods and beverages ($p<0.001$). **Conclusion:** Convenience and lower relative prices of food items purchased at supermarkets, in comparison to other food stores, are relevant to explain higher share of purchases of ultra-processed foods and beverages at supermarkets.

Keywords: food processing, food acquisition, cost, food demand, household budget survey, retail.

Introduction

The expansion of marketing and consumption of ultra-processed foods and beverages proceeds jointly with the increase in prevalence of overweight, obesity and other chronic diseases related to improper nutrition and insufficient physical activity in almost every country (SWINBURN et al., 2011; MONTEIRO et al., 2013). Several studies point to potential connections between the current pandemic in noncommunicable diseases related to obesity and the recent changes in food production and distribution structures worldwide, especially due to intrinsic characteristics of ultra-processed food and beverage products that favor overconsumption: convenience, price and flavor. However, ultra-processed foods and beverages are also marked by low nutritional quality (MONTEIRO et al., 2013; LOUZADA et al., 2015a,b,c).

Changes in food supply systems are related to greater availability of ultra-processed food products in populations' diets, especially considering the rise of large supermarket chains and the concentration of household food acquisition at supermarket retail stores (SWINBURN et al., 2011; REARDON & TIMMER, 2012; MONTEIRO et al., 2013; COSTA et al., 2013; GÓMEZ; RICKETTS, 2013; POPKIN, 2014; STANTON, 2015; TAILLIE, NG, POPKIN, 2016). Besides the aggressive massive advertisement for ultra-processed products on the TV, magazines and other media platforms, consumers are constantly induced to purchase large volumes of ultra-processed foods and beverages at supermarkets through pricing policies, constant introduction of new products, promotions and elaborate marketing strategies involving priority placement that allows more exposure of those products on shelves, among other things (HAWKES, 2008; REARDON & TIMMER, 2012; STANTON, 2015; STERN; NG; POPKIN, 2015).

Price is considered a primary determinant of food demand (ANDREYEVA, LONG, BROWNELL, 2010) and a core factor leading consumers to replace traditional food retail stores with supermarket' (HAWKES, 2008; CASPI et al., 2012; GÓMEZ; RICKETTS, 2013). Therefore, supermarket managers have pricing policies as one of the main strategies to influence consumers' decisions on what and how much to buy (HAWKES et al., 2008; REARDON & TIMMER, 2012).

Technological improvements, increasing returns of scale in food industry production, and use of low-cost ingredients and food additives allowed reduction in prices per calorie of ultra-processed products (POPKIN; ADAIR; NG, 2012; MONTEIRO et al., 2013; WIGGINS et al., 2015), reinforced by longer shelflife and lower production losses due to high levels of sugars, refined starches, fats, salt and various additives (POPKIN; ADAIR; NG, 2012; RICARDO & CLARO, 2012; MOUBARAC et al., 2013).

In Brazil, ultra-processed foods and beverages are still expensive in comparison to unprocessed or minimally processed foods and processed culinary ingredients (MOUBARAC et al., 2013; CLARO et al., 2016); however, the magnitude of price differences is dependent of the place of purchase (FARINA; NUNES, MONTEIRO, 2005; HAWKES, 2008). Moreover, relative prices of ultra-processed foods and beverages have been decreasing during the past 30 years compared to other food items in the Brazilian diet (YUBA et al., 2013), an increase in relative prices of healthy foods that suggests the encouragement of obesogenic eating patterns (WIGGINS et al., 2015).

Evidence shows that supermarket chains play an important role in the food retail scenario due to large-scale acquisition contracts negotiated with special conditions by using market power to drive prices of ultra-processed foods and beverages below prices usually charged by traditional retail outles (HAWKES, 2008; STANTON, 2015; TAILLIE, NG, POPKIN, 2016). A similar strategy is also applied to fresh foods; however, results for the latter are systematically inferior than for ultra-processed foods because of inherent characteristics of the products. Therefore, it supports the hypothesis that supermarkets have encouraged use of many ultra-processed foods by making them more purchases than fresh foods (HAWKES, 2008), especially in emerging countries (GÓMEZ; RICKETTS, 2013; POPKIN, 2014).

Results from previous studies, using data from the Brazilian Household Budget Survey carried out between 2002-2003 and 2009-2009, showed that supermarkets have made major contributions to the household foods and drinks purchased in Brazil, especially those commonly described as ultra-processed (COSTA et al., 2013; MACHADO, 2016). More widespread patronage of supermarkets is directly associated with greater use of ultra-processed foods, suggesting that convenience and price of ultra-processed foods and drinks at supermarkets explain their greater place in households. Thus, the study aims to evaluate the influence of convenience and prices of ultra-processed foods and beverages on the choice of foods purchased from supermarkets.

Material and methods

Database

Data on characteristics of household food purchases were gathered from the nationally representative 2008-2009 Household Budget Survey conducted by the Brazilian Institute of Geography and Statistics (IBGE) on a probabilistic sample of 55,970 Brazilian households. The survey used a complex clustered sampling procedure, with geographical and socioeconomic stratification of census tracts in the country, followed by two stage sample selection based on tracts and households.

In the sample selection, tracts of the 2000 Demographic Census were selected to obtain household strata with geographic and socioeconomic homogeneity, considering geographic location of the tracts (region, state, capital or other city, geographic locus, urban or rural setting) and spectrum of socioeconomic variation of households, based on educational attainment of the household head, resulting in formation of 550 household strata (IBGE, 2010).

Data collection

Household interviews were performed during one year period, in order to provide information on household budgets in different situations, including seasonal variations of food acquisitions, prices and income (IBGE, 2010). Data analyzed in the study includes records of foods and beverages bought for household consumption, during seven consecutive days for each household, registered by household members or trained interviewers (if necessary), including characteristics of food items purchased, the amount (in kilograms or liters), prices (in Brazilian currency, Reais, R$) and type of

food retail stores visited (e.g. supermarket, local market, other food stores). Considering the short reference period used for recording household expenditures on food, the survey does not allow to identify usual patterns of food acquisition for each household interviewed. Therefore, the unit of analysis in the study are household strata, according to the survey sample design (IBGE, 2010).

Variables

Using food composition tables, the energy content (kcal) was calculated from the amount of foods and beverages bought by each household, excluding non-edible items (UNICAMP, 2004; USDA, 2009). Items consumed were categorized according to the new food classification system, which considers the extent and the purpose of industrial food processing into four groups (MONTEIRO et al., 2016):

1. Unprocessed or minimally processed foods (e.g. rice, beans, meat, milk, eggs, fruit, roots and tubers, vegetables, and flour);
2. Processed culinary ingredients (e.g. sugar, oils and fats, culinary products used to cook foods from the previous group);
3. Processed foods (e.g. processed breads and cheese, canned fruit and fish, and salted and smoked meats);
4. Ultra-processed foods and beverages (e.g. cookies, snacks, candy, frozen and ready meals and soft drinks).

The fourth group, which is focus of interest in the study, includes industrial formulations of substances extracted from foods or synthesized based on food substrates or other organic sources (MONTEIRO et al., 2016). Food items included within the four groups previously described referred to 35 subgroups, used to estimate the variety in household purchases at each type of food store.

Household food purchases reported in the 2008-2009 Household Budget Survey referred to 357 different types of retail food stores, which were initially distributed into nine categories: supermarkets (including supermarkets, hypermarkets and wholeretail stores), small markets, street fairs/greengrocers/public markets, bakeries, small farmers, butchers, street vendors, bars/restaurants and others. The last eight groups were considered to deal with traditional food retail, thus, were clustered into one category 'other food stores'.

Considering the complex sampling design, variables referring to individuals' characteristics in the stratum were established using weighted average of individuals' characteristics within the stratum, e.g., income per capita per month of stratum *s* (I_{pcs}), expressed in Brazilian currency (Reais, R$), was obtained by dividing global income of *n* households *h* in the stratum *s* (I_{hs}) by the respective number of residents (r_{hs}), according to its weight in the sample (w_{hs}).

$$I_{pcs} = \sum_{h=1}^{n} \frac{I_{hs}}{r_{hs}} \times w_{hs}$$

Similar procedure was used to estimate age, educational attainment (in years), proportion of women, children (≤5 years old) and elderly adults (≥65 years old), proportion of calories per capita per day from food products purchased according to

type of food store (supermarket vs. other stores), and its respective average prices per thousand calories (R$/1,000 kcal). Market prices of food products within a certain stratum were considered valid for households that purchased the items or not, in order to encompass complete market demand system (i.e., including households that chose buying zero of a particular item due to market price) (IPEA, 2006). Control variables included in the model referred to geographic region and situation of the household in the stratum (state capital, metropolitan area, urban area and rural area).

Price imputation was based on the calculation of the median price paid by households at the same type of food store at the same decile of monthly income per capita and in the same geographic region (large region, state capital or countryside). Measures of central tendency and dispersion were used to compare variables before and after imputation of market prices, indicating good validity for the procedure adopted.

Relative prices of ultra-processed foods and beverages (group 4) acquired at supermarkets and other food stores were calculated by dividing the mean price of the groups and its subgroups by the mean price of other foods (combination of items in the groups 1, 2 and 3). Subsequently, a ratio of relative prices between different types of food stores was estimated by dividing the relative prices of ultra-processed foods purchased at supermarkets by the relative prices of the same food group obtained at other food stores.

A set of variables referring to the effect of convenience in food purchases according to type of store, and the effect of competition among different types of food stores were estimated for each strata, using the total number of subgroups bought in each store (ranging from 1 to 35, based on the classification of food subgroups proposed) and the total number of retail stores where each food subgroup was purchased (ranging from 1 to 9, based on the categorization of food stores proposed), respectivelly.

Data analysis

The share of calories and the mean prices from food groups and subgroups from supermarkets were compared to those obtained in other stores using test of means for independent samples (t-test). A ratio between the share of ultra-processed foods and beverages (calorie percentage) from supermarkets and at other food stores was calculated, and a linear regression model was used to check potential linear associations between the ratios of calorie percentage shares and relative prices of ultra-processed foods and beverages.

To test the hypothesis that household availability of ultra-processed foods from supermarkets are influenced by its prices, a log-log linear regression model was used to estimate price elasticity coefficients. The elasticity coefficient indicates the percentage variation in the share of ultra-processed foods and beverages from supermarkets corresponding to 1% variation in the prices of the food item (own-price elasticity). Elasticity coefficients correspond to regression coefficients (β) of explanatory variables in linear regression models of log-log type (MITTELHAMMER; JUDGE; MILLER, 2000). The general model used is defined as:

$$\ln(Q_s^u) = \alpha + \beta_1.\ln(P_s^u) + \beta_2.\ln(P_s^o) + \chi.(v) \qquad \text{[Eq.1]}$$

Where $\boldsymbol{Q_s^u}$ is the percentage of calories in ultra-processed foods and beverages acquired at supermarkets; $\boldsymbol{P_s^u}$ is the price per unit of energy of ultra-processed foods and beverages acquired at supermarkets (R$/1,000 kcal); $\boldsymbol{P_s^o}$ is the price per unit of energy of other foods complementary to ultra-processed foods and beverages acquired at supermarkets (R$/1,000 kcal); and $\boldsymbol{v}$ is a vector related to control variables.

Control variables included in the model included: geographic region; area (capital, metropolitan area, other urban areas and rural area); monthly income per capita (R$); residents' mean age; mean years of schooling of household heads; proportion of women, children under five years old and adults aged 65 or more; mean price (R$/1,000 kcal) of ultra-processed foods from other food stores; mean price (R$/1,000 kcal) of other foods complementary to ultra-processed foods from other food stores; total number of retail outlets visited for food shopping (competition effect); and total number of food items from each store (convenience effect).

The global fit of the model was analyzed using likelihood ratio test with significance levels ≤0.05. Extensions to the general regression model, including quadratic terms of variables referring to food prices and income per capita, were tested to identify nonlinear relationships between variables and the share of ultra-processed foods and beverages calories from supermarkets.

Weighted analyzes were performed in survey module to consider the effect of complex sampling procedures adopted in the Brazilian Household Budget Survey, in order to allow extrapolation of results for representativeness of the Brazilian population, considering a 95% confidence interval. The statistical analyses were performed using Stata/SE, version 14 (Stata Corp., CollegeStation, United States).

Results

The daily per capita energy available from food items bought for household consumption was 1,719 kcal in 2008-2009: 1,016 kcal were from foods purchased at supermarkets, 703 kcal were from foods from other types of food stores. Supermarkets accounted for the highest percentage of calories per capita in urban settings, in the Center-South regions and in the largest income quintiles (Table 1).

Table 1

Unprocessed or minimally processed foods accounted for 48.0% of calories from supermarkets and 54.0% of calories from other food stores (Table 2). Rice, beans, meat, milk and yogurt accounted for 67% of total food available from both types of food stores. Substantial differences between supermarkets and other food stores were observed in the calorie share of wheat flour (2.8% vs. 1.3%) and, conversely, in the calorie share of cassava flour (1.3% vs. 5.0%), fruit (1.5% vs. 3.3%), root and tubers (0.8% vs. 1.5%), eggs (0.5% vs. 1.0%) and fish (0.2% vs. 0.9%).

The share of processed culinary ingredients purchased at supermarkets was almost the double of the share acquired at other food stores; whilst the share of processed foods purchased at other food stores was almost four times larger in comparison to the share from supermarkets. The largest difference in processed foods was the high share of breads bought at 'other stores'.

Ultra-processed foods and beverages accounted for 19.2% of calories purchased for household consumption at supermarkets, 25% higher in comparison to purchases from other food stores (15.3%). The share of cookies, crackers and chips, soft drinks, bread and ultra-processed cheese was similar at different types of food stores. The larger differences between purchases made at supermarkets and at other food stores were found in the subgroups of other sugary drinks (0.8% vs. 0.2%) and sauces and spreads (0.5% vs. 0.2%). The share of ice cream, chocolate and other sweets was higher at supermarkets (2.6%) than at other food stores (1.2%).

The mean price per calorie of food groups and subgroups from supermarkets was 37% lower than at other food stores. In addition, supermarkets presented lower prices for unprocessed or minimally processed food groups, processed culinary ingredients and ultra-processed foods and beverages; although there were substantial differences among prices of food groups components. Unprocessed or minimally processed foods and processed culinary ingredients with higher prices at supermarkets include milk and yogurt, cassava flour, fruit, roots and tubers, eggs, fish, oils and fats.

The group of processed foods was the only with higher mean prices at supermarkets, and its components showed similar prices. In relation to ultra-processed foods and beverages, subgroups had lower prices at supermarkets, except for ultra-processed bread. Regardless the type of food store, the group of ultra-processed products had higher prices than the mean prices of complementary foods (combination of groups 1, 2 and 3). However, prices of ultra-processed products from supermarkets were nearly 15% lower than charged at other food stores (Table 2).

Table 2

The consumption of ultra-processed food items was considerably higher at supermarkets, according to its lower relative prices in comparison to other food stores (e.g. the proportion of calories from other sugary drinks purchased at supermarkets was higher in comparison to other food stores due to relative prices 20% lower). The exceptions were ultra-processed cheeses, which presented similar level of consumption and prices at the distinct types of food stores.

The ratio of calories from ultra-processed foods obtained at supermarkets, in comparison to other stores, showed a significant inverse association with the ratio of relative prices paid for ultra-processed foods at supermarkets, in comparison to other food stores (Figure 1). That is, the lower the relative price of ultra-processed foods at supermarkets compared to other stores, the higher its consumption at household level.

Figure 1

Estimation of price elasticity in the model adjusted for control variables (model 3) was –0.59; indicating that 1% increase in the relative prices of ultra-processed foods acquired at supermarkets would lead to 0.59% decrease in purchases (R^2=0.75; $p<0.001$). Furthermore, the convenience effect presented coefficient 1.83 ($p<0.001$), and relative prices of ultra-processed foods acquired at other food stores had elasticity coefficient 0.40 ($p<0.001$), indicating the influence of both convenience and substitution

effects, respectively (Table 3). There was no evidence of significant nonlinear relationships between ultra-processed food prices and share of purchases made at supermarkets.

Table 3

Discussion

The present study is the first population-based investigation to analyze the relationship between relative prices, convenience and purchase of foods at different types of food retail stores (supermarkets and other food stores) applying the innovative classification of foods based on the extent and the purpose of industrial processing. The results indicate that the demand for ultra-processed food items was sensitive to relative prices and significantly influenced by convenience, indicating that price and convenience act jointly to stimulate the purchase of ultra-processed foods and beverages at supermarkets in Brazil.

Several other countries have also shown similar patterns of more food being bought at supermarkets in place of the more traditional food retailers such as street fairs, small markets and butchers shops (REARDON; HENSON; BERDEGUÉ, 2007; REARDON & TIMMER, 2012; COSTA et al., 2013; POPKIN, 2014).

Supermarkets have become dominant in global food supply chains (SWINBURN et al., 2011; STANTON, 2015; TAILLIE, NG, POPKIN, 2016). Consumers usually refer to convenience and variety with high quality at low prices as one of the main factors for preferential purchasing at supermarkets (CASPI et al., 2012; KRUKOWSKI et al., 2012; GÓMEZ & RICKETTS, 2013). During the 1990s, there were rapid changes in the retail sector in Brazil, including increased concentration of food retail sales at five major supermarket chains (MONTEIRO; FARINA; NUNES, 2012).

Our study shows that the highest proportion of foods were bought from supermarkets, especially in households with the highest income, in urban areas and regions with the highest development index. Previous studies indicate that access to supermarkets is directly related to the population's income, a trend observed mostly in emerging countries due to the patterns of expansion adopted by supermarkets, initially targeting consumers with higher income in large urban centers, a strategy to have higher returns in cities with substantial population concentration (REARDON; HENSON; BERDEGUÉ, 2007; REARDON & TIMMER, 2012).

Subsequent phases for supermarkets business expansion include merges and acquisitions of local retailers and small neighborhood and discount stores (REARDON & TIMMER, 2012; EUROMONITOR, 2015), especially due to trends in purchasing food at neighborhood stores (FARINA; NUNES, MONTEIRO, 2005). The supermarket chains have been expanding participation in terms of market share; thus, increase bargaining power with suppliers and managing to operate with lower costs due to production scale (HAWKES, 2008; REARDON; HENSON; BERDEGUÉ, 2007; REARDON & TIMMER, 2012; STANTON, 2015).

The results of the study showed lower prices charged by supermarkets in three food groups, in comparison to other food stores. Almost all subgroups of ultra-

processed products had lower prices at supermarkets. Moreover, the proportion of calories from ultra-processed foods and beverages from supermarkets was 25% higher than at other food stores, whilst relative prices were almost 15% lower at supermarkets. Plenty of evidence supports the hypothesis that prices are major determinants of increased consumption of ultra-processed foods (LEE; RALSTON; TRUBY, 2011; WENDT & TODD, 2011; RICARDO & CLARO, 2012; MOUBARAC et al., 2013; POWELL et al., 2013), and probably linked to the rising incidence of obesity (POWELL et al., 2013; FINKELSTEIN et al., 2014); whilst there has been increase in relative prices of healthy foods, especially fruits and vegetables in several countries (WENDT & TODD, 2011; LEE; RALSTON; TRUBY, 2011; YUBA et al., 2013; POWELL et al., 2013), including Brazil (YUBA et al., 2013; WIGGINS et al., 2015).

Supermarkets are important outlets for the food industry to offer consumers a wide variety of ultra-processed products (COSTA et al., 2013; STANTON, 2015; POPKIN, ADAIR, NG, 2015). Price, assortment, promotion/advertising and placement are used to influence consumers' decision about what and how much to buy (HAWKES, 2008; COHEN & BABEY, 2012; GLANZ et al., 2012; STANTON, 2015). Point of sale strategies used with ultra-processed foods exploit convenience and stimulate impulsive purchase (HAWKES, 2008; COHEN & BABEY, 2012; GLANZ et al., 2012; STANTON, 2015). Tactics include relative price discounts on large packages, prominent large displays at the end of the supermarket aisles and placing snack food lines close to cash registers (GLANZ et al., 2012; COHEN & BABEY, 2012; STANTON, 2015).

In line with literature available for high-income countries, the findings showed that the calorie share of ultra-processed foods bought from supermarkets in Brazil can be explained either by their relative price or by their price at other food stores, showing the role of competition through prices in food retail (FARINA, NUNES, MONTEIRO, 2005; MONTEIRO, FARINA, NUNES, 2012). However, there was also an important influence due to the effect of convenience on purchases of ultra-processed foods and beverages at supermarkets, especially combined with lower relative prices at supermarkets in comparison to other food stores. Lower prices at supermarkets tend to attract consumers, encouraging bulk purchases of food items, especially ultra-processed foods; thus reinforcing the consumer evaluation of food retail based on the "convenience price" (GLANZ et al., 2012), a combination of perceptions on product quality, monetary price and time and travel costs (BRUNNER; VAN DER HORS; SIEGRIST, 2010).

Ultra-processed foods and beverages are convenient for retail chains and consumers, because of longer shelflife, ease of transportation and storage, high profit margins, and practicality in access and consumption (BRUNNER; VAN DER HORS; SIEGRIST, 2010; REARDON & TIMMER, 2012; MONTEIRO et al., 2013; STANTON, 2015). Therefore, convenience is a business strategy for retailers and a barrier to the adoption of healthy eating habits by consumers (BRUNNER; VAN DER HORS; SIEGRIST, 2010; GLANZ et al., 2012; HAWKES et al., 2015).

Also, price is considered an obstacle to buying healthy foods, especially for individuals with lower socioeconomic status (STEENHUIS; WATERLANDER; DE MUL, 2011; HOLLYWOOD et al., 2013; MINISTRY OF HEALTH OF BRAZIL,

2014). Note, however, that in Brazil, the cost of diets based on fresh foods and meals prepared at home is still lower than the cost of diets based on ultra-processed foods and beverages (CLARO et al., 2016).

While the great concentration of food purchases at supermarkets might have contributed to the improvement of food safety in these countries (REARDON & TIMMER, 2012), it also has negative effects. The expansion of supermarket chains and the move by populations to buy their foods there can worsen diet quality (VOLPE, OKRENT, LEIBTAG, 2013) and play a role in increasing the incidence of obesity (CHAIX et al., 2012; TAILLIE, NG, POPKIN, 2015, STANTON, 2015). To create healthy food environments, we need fewer ultra-processed foods (MINISTRY OF HEALTH OF BRAZIL, 2014, MONTEIRO et al., 2017). This study shows that dietary guidelines, public policies and public health interventions must consider the obstacles to healthy food environments that arise from food supply chains and direct (relative prices) and indirect (convenience) factors (MINISTRY OF HEALTH OF BRAZIL, 2014; ROBERTO et al., 2015; HAWKES et al., 2015).

There is lack of evidences regarding the effects of interventions focusing prices in food stores in low- and middle-income countries. In high-income countries, interventions directed to the inclusion of supermarkets in areas considered "food deserts" were ineffective to ensure access to healthy foods and especially to reduce consumption of ultra-processed foods and beverages (BOONE-HEINONEN et al., 2011; MAYNE; AUCHINCLOSS; MICHAEL, 2015). On the other hand, combined strategies for improving food microenvironment, focusing on availability, product placement, advertising and price have shown positive effects (ESCARON et al., 2013; OLSTAD et al., 2016).

Food purchases rely on multiple determinants (SWINBURN et al., 2011; STEENHUIS, WATERLANDER, DE MUL, 2011; COHEN & BABEY, 2012), and there is a need for combined initiatives to promote consumption of healthy foods based on greater access to their supply (ESCARON et al., 2013; ROBERTO et al., 2015; MAYNE, AUCHINCLOSS, MICHAEL, 2015; OLSTAD et al., 2016).

The limitations of the study include the short period of reference for data collection on food purchases (seven days) it was not possible to make inferences on usual food purchasing patterns for household consumption, including seasonal and price variations. Consequently, the study relies on data from homogeneous household aggregates, considered study units referring to diverse geographical locations and socioeconomic spectra. Another limitation inherent to the study refers to potential errors in the processes involving record of information on food prices. To minimize that, respondents were asked to keep purchase receipts during data collection (IBGE, 2010).

An important contribution of the study was to challenge the assertion that presence of supermarkets may be considered as proxy for access to healthy eating patterns (MORLAND & EVENSON, 2009; WALKER; KEANE; BURKE, 2010), exposing the ambiguous role played by supermarket chains, especially referring to the pressure for lowering prices of unhealthy foods using market power, in comparison to other retail outlets. The elasticity coefficient estimates produced in the study were based on relative prices of food products through comparison of prices in different types of food retail stores, an unprecedented approach to assess the effect of prices and other

determinants of food purchases from the perspective of health promotion. Furthermore, studies usually focus on the evaluation of access to and characteristics of supermarkets in high-income countries (MORLAND & EVENSON, 2009; WALKER; KEANE; BURKE, 2010), and there is lack of evidences regarding food consumption using a novel food classification based on industrial processing (LOUZADA et al., 2015c; MONTEIRO, 2016), food environment (VEDOVATO et al., 2015), and relative prices assessment (MOUBARAC et al., 2013; CLARO et al., 2016).

Conclusion

The lower price of food items bought at supermarkets, in comparison to other food stores, is relevant to explain the higher share of ultra-processed food purchases at supermarkets. However, in addition to price, convenience was also relevant to explain the increase in ultra-processed food purchases and, therefore, its consumption in Brazil.

The results obtained suggests that pricing strategies adopted by supermarkets due to their market power may be compelling to the reduction of prices of ultra-processed foods and beverages in the Brazilian food retail market, in detriment of traditional food retail stores and other outlets for healthy food, thereby encouraging consumption of ultra-processed foods among the population.

Understanding the role of supermarkets in favoring the consumption of ultra-processed foods through price and convenience mechanisms may help to advance proposals of public policies and actions aimed at democratizing food supply systems to promote access to proper diets and healthy foods.

References

ANDREYEVA, T.; LONG, M. W.; BROWNELL, K. D. (2010). The Impact of Food Prices on Consumption: A Systematic Review of Research on the Price Elasticity of Demand for Food. *American Journal of Public Health*, 100(2): 216-222.

BOONE-HEINONEN, J.; GORDON-LARSEN, P.; KIEFE, C. I.; SHIKANY, J. M.; LEWIS, C. E.; POPKIN, B. M. (2011). Fast Food Restaurants and Food Stores Longitudinal Associations With Diet in Young to Middle-aged Adults: The CARDIA Study. *Archives of Internal Medicine*, 171(13): 1162-1170.

BRUNNER, T. A.; VAN DER HORS, K.; SIEGRIST, M. (2010). Convenience food products. Drivers for consumption. *Appetite*, 55: 498–506.

CASPI, C. E.; SORENSEN, G.; SUBRAMANIAN, S. V.; KAWACHI, I. (2012). The local food environment and diet: A systematic review. *Health Place*, 18(5): 1172–87.

CHAIX, B.; BEAN, K.; DANIEL, M.; ZENK, S. N.; KESTENS, Y.; CHARREIRE, H.; LEAL, C.; THOMAS, F.; KARUSISI. N.; WEBER, C.; OPPERT, J.M.; SIMON, C.; MERLO, J.; PANNIER, B. (2012). Associations of Supermarket Characteristics with Weight Status and Body Fat: A Multilevel Analysis of Individuals within Supermarkets (RECORD Study). *PLoS One*, 7(4): 1-10.

CLARO R. M.; MAIA, E. G.; COSTA, B. V. L.; DINIZ, D. P. (2016). Food prices in Brazil: prefer cooking to ultra-processed foods. *Cadernos de Saúde Pública*, 32(8).

COHEN, D. A.; BABEY, S. A. (2012). Contextual Influences on Eating Behaviors: Heuristic Processing and Dietary Choices. *Obesity Reviews*, 13(9): 766–779.

COSTA, J. C.; CLARO, R. M.; MARTINS, A. P. B.; LEVY, R. B. (2013). Food purchasing sites. Repercussions for healthy eating. *Appetite*, 70: 99-108.

ESCARON, A. L.; MEINEM, A. M.; NITZE, S. A.; MARTINEZ-DONATE, A. P. (2013). Supermarket and Grocery Store–Based Interventions to Promote Healthful Food Choices and Eating Practices: A Systematic Review. *Preventive Chronic Disease*, 10(120156).

EUROMONITOR. *Global Consumer Trends for 2015*. (2015). Available on: <www.euromonitor.com>. Acessado em dez. 2015.

FARINA, E. M. M. Q.; NUNES, R.; MONTEIRO, G. F. (2005). Supermarkets and their Impacts on the Agrifood System of Brazil: The Competition Among Retailers. *Agribusiness*, 21(2): 133-47.

FINKELSTEIN, E. A.; STROMBOTNE, K. L.; ZHEN, C.; EPSTEIN, L. H. (2014). Food Prices and Obesity: A Review. American Society for Nutrition. *Advances in Nutrition*, 5: 818–821.

GLANZ, K.; BADER, M. D. M.; IYER, S. (2012). Retail Grocery Store Marketing Strategies and Obesity. *American Journal of Preventive Medicine*, 42(5): 503-512.

GÓMEZ, M. I. & RICKETTS, K. D. (2013). Food value chain transformations in developing countries: Selected hypotheses on nutritional implications. *Food Policy*, 42: 139-150.

HAWKES, C. (2008). Dietary implications of supermarket development: a global perspective. *Development Policy Review*, 26(6): 657–92.

HAWKES, C.; SMITH, T. G.; JEWELL, J.; WARDLE, J.; HAMMOND, R. A.; FRIEL, S.; THOW, A. M.; KAIN, J. (2015). Smart food policies for obesity prevention. *Lancet*, 385(9985): 2410–21.

HOLLYWOOD, L. E.; CUSKELLY, G. J.; O'BRIEN, M.; MCCONNON, A.; BARNETT, J. RAATS, M. M.; DEAN, M. (2013). Healthful grocery shopping. Perceptions and barriers. *Appetite,* 70: 119–126.

IBGE. Instituto Brasileiro de Geografia e Estatística. (2010). Pesquisa de Orçamentos Familiares 2008-2009. *Análise da disponibilidade domiciliar de alimentos e do estado nutricional no Brasil.* Rio de Janeiro: IBGE.

IPEA. Instituto de Pesquisas Econômicas Aplicadas. (2006). *Gasto e consumo das famílias brasileiras contemporâneas*. Brasília: IPEA, 378p.

KRUKOWSKI, R. A., MCSWEENWEY, J., SPARKS, C., WEST, D. S. (2012). Qualitative study of influences on food store choice. *Appetite*, 59(2): 510–516.

LEE, J. H.; RALSTON, R. A.; TRUBY, H. (2011). Influence of food cost on diet quality and risk factors for chronic disease: a systematic review. *Nutrition & Dietetics*, 68: 248–261.

LOUZADA, M. L. C.; BARALDI, L. G.; MARTINEZ, E.; MARTINS, A. P. B.; CANELLA, D. S.; MOUBARAC, J.; LEVY, R. B.; CANNON, G.; AFSHIN, A.; IMAMURA, F.; MOZAFFARIAN, D.; MONTEIRO, C. A. (2015a). Consumption of ultra-processed foods and obesity in Brazilian adolescents and adults. *Preventive Medicine*, 81: 9-15.

LOUZADA, M. L. C.; MARTINS, A. P. B.; CANELLA, D. S. ; BARALDI, L. G. ; LEVY, R. B. ; CLARO, R. M. ; MOUBARAC, J. ; CANNON, G. ; MONTEIRO, C. A. (2015b). Ultra-processed foods and the nutritional dietary profile in Brazil. *Revista de Saúde Pública*, 49: 2-11.

LOUZADA, M. L. C.; MARTINS, A. P. B.; CANELLA, D. S. ; BARALDI, L. G. ; LEVY, R. B. ; CLARO, R. M. ; MOUBARAC, J. ; CANNON, G. ; MONTEIRO, C. A. (2015c). Impact of ultra-processed foods on micronutrient content in the Brazilian diet. *Revista de Saúde Pública*, 49:38.

MACHADO, P.P. The influence of the supermarkets on the availability and price of ultra-processed food and drink products consumed in Brazil. [Dissertation]. São Paulo: School of Public Health, University of São Paulo; 2016.

MAYNE, S. L.; AUCHINCLOSS, A. H.; MICHAEL, Y. L. (2015). Impact of policy and built environment changes on obesity-related outcomes: a systematic review of naturally occurring experiments. *Obesity Reviews*, 16: 362-375.

MINISTRY OF HEALTH OF BRAZIL. Secretariat of Health Care. Primary Health Care Department. Dietary Guidelines for the Brazilian population (2014); translated by Carlos Augusto Monteiro – Brasília: Ministry of Health of Brazil, 156 p.

MITTELHAMMER, R. C.; JUDGE, G. G.; MILLER, D. J. (2000). *Econometric Foundation:* Cambridge, 756p.

MONTEIRO, C. A.; CANNON, G.; MOUBARAC, J-C.; LEVY, R. B.; LOUZADA, M. L.; JAIME, P. (2017). The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutrition*, p. 1-13.

MONTEIRO, C. A.; CANNON, G.; LEVY, R. B.; MOUBARAC, J-C.; JAIME, P.; MARTINS, A. P.; CANELLA, D.; LOUZADA, M. L.; PARRA, D.; WITH RICARDO, C.; CALIXTO, G.; MACHADO, P.; MARTINS, C.; MARTINEZ, E.; BARALDI, L.; GARZILLO, J.; SATTAMINI, I. (2016). NOVA. The star shines bright. [Food classification. Public health]. *World Nutrition*, 7(1-3): 28-38.

MONTEIRO, C. A.; MOUBARAC, J-C.; CANNON, G.; NG, S. W.; POPKIN, B. (2013). Ultra-processed products are becoming dominant in the global food system. *Obesity Reviews*, 14(2): 21-28.

MONTEIRO, G.; FARINA, E.; NUNES, R. (2012). Food-Retail Development and the Myth of Everyday Low Prices: The Case of Brazil. *Development Policy Review*, 30(1): 49-66.

MORLAND, K. B. & EVENSON, K. R. (2009). Obesity prevalence and the local food environment. *Health Place*, 5(2): 491–495.

MOUBARAC, J-C; CLARO, R. M.; BARALDI, L. G.; LEVY, R. B.; MARTINS, A. P. B.; CANNON, G.; MONTEIRO, C. A. (2013). International differences in cost and consumption of ready-to-consume food and drink products: United Kingdom and Brazil, 2008-2009. *Global Public Health*, 8(7): 845-56.

OLSTAD, D. L.; BALL, K.; ABBOTT, G.; MCNAUGHTON, S. A.; LE, H. N. D.; MHURCHU, C. N.; POLLARD, C.; CRAWFORD, D. A. (2016). A process evaluation of the Supermarket Healthy Eating for Life (SHELf) randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*, 13(27).

POPKIN, B. M. (2014). Nutrition, agriculture and the global food system in low and middle income countries. *Food Policy*, 47, 91-96.

POPKIN, B. M.; ADAIR, L. S.; NG, S. W. (2012). Global nutrition transition and the pandemic of obesity in developing countries. *Nutrition Reviews*, 70(1): 3-21.

POWELL, L. M.; SLATER, S.; MIRTCHEVA, D.; BAO, Y.; CHALOUPKA, F. J. (2007). Food store availability and neighborhood characteristics in the United States *Preventive Medicine*,44: 189–195.

REARDON, T. & TIMMER, C. P. (2012). The economics of the food system revolution. *Annual Review of Resource Economics*, 4: 225–264.

REARDON, T.; HENSON, S.; BERDEGUÉ, J. (2007). 'Proactive fast-tracking' diffusion of supermarkets in developing countries: implications for market institutions and trade. *Journal of Economic Geography*, 7: 399-431.

RICARDO, C. Z. & CLARO, R. M. Custo da alimentação e densidade energética da dieta no Brasil, 2008-2009. (2012). *Caderno de Saúde Pública*, 28(12): 2349-2361.

ROBERTO, C. A.; SWINBURN, B.; HAWKES, C.; HUANGM T. T-K.; COSTA, S. A.; ASHE, M.; ZWICKER, L.; CAWLEY, J. H.; BROWNELL, K. D. (2015). Patchy progress on obesity prevention: emerging examples, entrenched barriers, and new thinking. *Lancet*, 385(9985): 2400–09.

STANTON, R. A. (2015). Food Retailers and Obesity. *Current Obesity Reports*, 4: 54–59.

STEENHUIS, I. H.; WATERLANDER, W. E.; DE MUL, A. (2011). Consumer food choices: the role of price and pricing strategies. *Public Health Nutrition* 14: 2220–2226.

STERN, D.; NG, S. W.; POPKIN, B. M. (2015). The Nutrient Content of U.S. Household Food Purchases by Store Type. *American Journal of Preventive Medicine*, 50(2): 180-190.

SWINBURN, B. A.; SACKS, G.; HALL, K. D.; McPHERSON, K.; FINEGOOD, D.T.; MOODIE, M. L.; GORTMAKER, S. (2011). The global obesity pandemic: shaped by global drivers and local environments. *Lancet*, 378(9793): 804–814.

TAILLIE, L. S.; NG, S. W.; POPKIN, B. M. (2016). Global growth of "big box" stores and the potential impact on human health and nutrition. *Nutrition Reviews*, 74(2): 83-97.

UNICAMP. Universidade Estadual Campinas. (2004). Núcleo de Estudos e Pesquisa em Alimentação. *Tabela Brasileira de Composição de Alimentos* – TACO. version 1. Campinas.

USDA. United States Department of Agriculture. (2009). Agricultural Research Service. *USDA national nutrient database for standard reference*. Release 24. Beltsville.

VEDOVATO, G. M.; TRUDE, A. C. B.; KHARMATS, A. Y.; MARTINS, P. A. (2015). Degree of food processing of household acquisition patterns in a Brazilian urban area is related to food buying preferences and perceived food environment. *Appetite*, 87: 296-302.

VOLPE, R.; OKRENT, A.; LEIBTAG, E. (2013). The effect of supercenter-format stores on the healthfulness of consumers' grocery purchases. *American Journal of Agricultural Economics*, 95(3): 568–89.

663 WALKER, R. E.; KEANE, C. R.; BURKE, J. G. (2010). Disparities and access to
664 healthy food in the United States: A review of food deserts literature. *Health Place*,
665 16(5): 876-84.

666 WENDT, M.; TODD, J. E. (2011). *The Effect of Food and Beverage Prices on*
667 *Children's Weights.* ERR-118, U.S. Department of Agriculture, Economic Research
668 Service.
669
670 WIGGINS, S.; KEATS, S.; HAN, E.; SHIMOKAWA, S.; ALBERTO, J.;
671 HERNÁNDEZ, V.; CLARO, R. M. The rising cost of a healthy diet: Changing
672 relative prices of foods in high-income and emerging economies. *Overseas*
673 *Development Institute*, 2015.
674
675 YUBA, T. Y.; SARTI, F. M.; CAMPINO, A. C. C.; CARMO, H. C. E. (2013).
676 Evolução dos preços relativos de grupos alimentares entre 1939 e 2010, em São
677 Paulo, SP. *Revista de Saúde Pública*, 47(3): 549-559.

TABLES

Table 1 – Proportion of calories (%) from food items acquired for household consumption at different types of food stores, according to strata characteristics. Brazil, 2008-2009.

Strata characteristics	Type of food store			
	Supermarkets		Other stores	
	%	(95%CI)	%	(95%CI)
Household setting				
Urban	62.2	(59.7-64.6)	37.8	(35.4-40.3)
Rural	42.3	(38.7-45.9)	57.7	(54.1-61.3)
Region				
North (HDI 0.667)*	39.4	(34.3-44.4)	60.6	(55.6-65.7)
Northeast (HDI 0.663) *	38.9	(36.2-41.6)	61.1	(58.4-63.8)
Southeast (HDI 0.766) *	69.2	(66.5-71.9)	30.8	(28.1-33.5)
South (HDI 0.754) *	66.7	(63.8-69.6)	33.3	(30.4-36.2)
Central-West (HDI 0.757)*	71.9	(68.5-75.2)	28.1	(24.8-31.5)
Income quintile				
1st quintile	34.7	(31.5-37.9)	65.3	(62.1-68.5)
2nd quintile	51.8	(48.1-55.5)	48.2	(44.5-51.9)
3rd quintile	64.2	(60.3-68.1)	35.8	(31.9-39.7)
4th quintile	70.6	(67.6-73.7)	29.4	(26.3-32.4)
5th quintile	74.3	(72.3-76.4)	25.7	(23.6-27.7)

(*) Data on Human Development Index (HDI) obtained from the United Nations Program for Human Development (UNDP) referring to 2010.

Table 2 – Proportion of calories (%) and prices (R$ per 1,000 calories) referring to food groups and subgroups acquired at different types of food stores. Brazil, 2008-2009.

Food groups	Total		Supermarkets		Other stores	
	%	R$/1,000kcal	%	R$/1,000kcal	%	R$/1,000kcal
Unprocessed or minimally processed food	**50.4**	**2.07**	**48.0**	**1.83**	**53.7**[a]	**2.68**[a]
Rice	16.2	0.52	18.8	0.53	12.5[a]	0.54[a]
Beans	5.1	1.03	5.1	0.99	5.2	1.00
Meats	8.9	4.44	7.0	4.26	11.6[a]	4.53[a]
Milk and natural yoghurt	4.5	2.38	3.9	2.76	5.3[a]	2.47[a]
Cassava flour	2.8	0.50	1.3	0.49	5.0[a]	0.47[a]
Wheat flour	2.2	0.53	2.8	0.55	1.3[a]	0.57[a]
Pasta	2.4	0.97	2.9	0.93	1.7[a]	0.98[a]
Fruits	2.2	4.47	1.5	4.86	3.3[a]	4.02[a]
Roots and tubers	1.1	2.25	0.8	2.59	1.5[a]	2.22[a]
Vegetables	0.7	10.50	0.6	9.46	0.9[a]	11.70[a]
Eggs	0.7	3.03	0.5	3.56	1.0[a]	3.19[a]
Fish	0.5	8.31	0.2	10.50	0.9[a]	7.75[a]
Other unprocessed or minimally processed foods[b]	3.0	2.98	2.6	4.98	3.5[a]	4.59[a]
Processed culinary ingredients	**23.3**	**0.42**	**28.8**	**0.42**	**15.4**[a]	**0.72**[a]
Table sugar	11.2	0.3	13.3	0.27	8.1[a]	0.31
Vegetable oils	11.2	0.4	14.5	0.39	6.4[a]	0.36
Animal fats (butter, lard)	0.7	1.6	0.8	1.74	0.7[a]	1.54
Other culinary ingredients[c]	0.2	2.3	0.2	2.63	0.2	4.28
Processed food	**8.9**	**2.01**	**4.0**	**2.93**	**15.6**[a]	**1.71**[a]
Processed breads	6.6	1.43	1.9	1.48	13.3[a]	1.42[a]
Processed cheese	1.0	3.89	1.0	4.06	1.0	3.83[a]
Cured/salted meats	0.8	3.26	0.7	3.73	1.0[a]	3.28[a]
Preserved fish and eggs	0.1	5.08	0.1	5.35	0.1	4.61[a]
Preserved vegetables	0.1	3.16	0.1	9.31	0.1	9.40
Preserved fruits	0.2	6.02	0.2	3.47	0.1[a]	2.97[a]
Ultra-processed food	**17.5**	**2.51**	**19.2**	**2.43**	**15.3**[a]	**2.74**[a]
Biscuits and cakes	3.2	1.65	3.2	1.58	3.0[a]	1.78[a]
Ice cream, chocolates, sweets	2.0	2.55	2.6	2.46	1.2[a]	2.93[a]
Crackers and chips	1.5	1.46	1.6	1.48	1.4[a]	1.53[a]
Soft drinks	1.5	4.32	1.7	4.22	1.4[a]	4.72[a]
Other sugary drinks	0.5	9.51	0.8	9.64	0.2[a]	12.10[a]
Margarine	1.7	0.91	2.1	0.91	1.2[a]	0.95[a]
Breads	1.2	1.99	1.1	2.07	1.3[a]	2.00[a]
Hamburger and sausages	2.5	2.57	2.8	2.60	2.1[a]	2.75[a]
Ready meals, frozen foods	2.2	3.15	1.9	2.52	2.7[a]	3.86[a]
Sauces and spreads	0.4	7.33	0.5	7.84	0.2[a]	10.70[a]
Breakfast cereals	0.7	2.41	0.8	2.45	0.5[a]	2.57[a]
Ultraprocessed cheeses	0.1	4.91	0.1	5.05	0.1	5.15[a]
All items	100.0	1.75	100.0	1.57	100.0	2.15

1 kcal = 4.184 kJ. Numbers in bold highlight major groups and are not included in the total sum.

a $p < 0.001$ for t-test of means from independent samples.

b Grains (other than rice and beans), other types of flour, seafood, nuts and seeds, tea, coffee and dry spices.

c Other sugars (such as honey, molasses, *rapadura* – a type of candy made from sugarcane juice), starch, coconut milk and coconut flakes.

Table 3 – Price elasticity coefficients of proportion of calories from ultra-processed foods and beverages acquired at supermarkets in relation to its mean price (R$ per 1,000 calories), obtained through regression models. Brazil, 2008-2009.

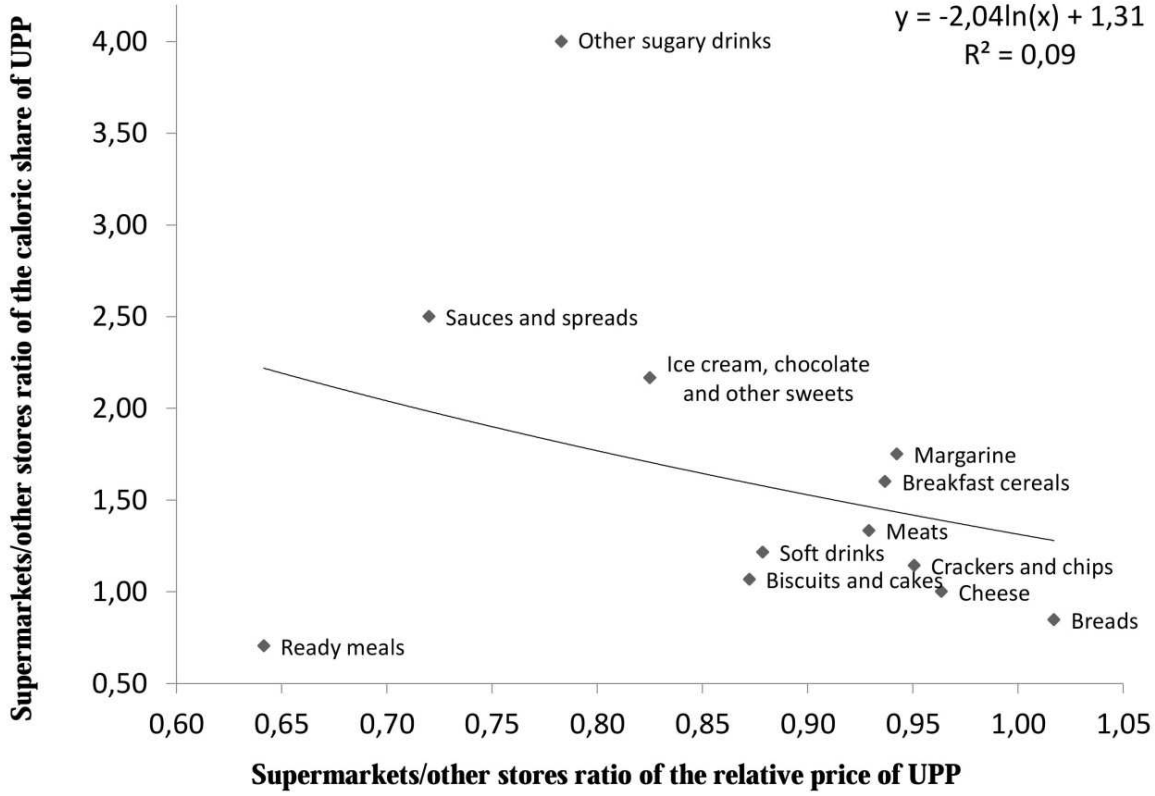
Variables	Model 1	Model 2	Model 3
	β (95%CI)	β (95%CI)	β (95%IC)
Price of ultra-processed foods at supermermarkets	0.60 (0.44; 0.76)	0.41 (0.13; 0.68)	-0.59 (-0.82; -0.36)
Price of complementary foods[a] at supermermarkets		0.22 (-0.09; 0.44)	0.06 (-0.09; 0.20)
Price of ultra-processed foods at other stores			0.40 (0.25; 0.54)
Convenience at supermarkets			1.83 (1.51; 2.15)
Convenience at other stores			-0.16 (-0.23; -0.09)
Income (R$/person/month)			0.21 (0.12; 0.30)
Setting (0 = rural, 1 = urban)			-0.05 (-0.15; 0.05)
Schooling of heads of household			0.16 (0.23;0.09)
Region			
North			
Northeast			0.03 (-0.12; 0.18)
Southeast			0.19 (0.05; 0.32)
South			0.25 (0.11; 0.39)
Central-West			0.26 (0.12; 0.39)
R^2	0.09	0.10	0.75

[a] Complementary foods correspond to unprocessed or minimally processed foods, processed culinary ingredients and processed foods.

1 kcal = 4.184 kJ.

FIGURES

Figure 1 – Relationship between the ratio of caloric shares and relative prices of ultra-processed food products obtained at supermarkets in comparison to other food stores. Brazil, 2008-2009.



UPP: ultra-processed products