

Availability of added sugars in Brazil: distribution, food sources and time trends

Disponibilidade de “açúcares de adição” no Brasil: distribuição, fontes alimentares e tendência temporal

Abstract

Objective: To describe the regional and socio-economic distribution of consumption of added sugar in Brazil in 2002/03, particularly products, sources of sugar and trends in the past 15 years. **Methods:** The study used data from Household Budget Surveys since the 1980s about the type and quantity of food and beverages bought by Brazilian families. Different indicators were analyzed: % of sugar calories over the total diet energy and caloric % of table sugar fractions and sugar added to processed food/sugar calories of diet. **Results:** In 2002/03, of the total energy available for consumption, 16.7% came from added sugar in all regional and socio-economic strata. The table sugar/sugar added to processed food ratio was inversely proportional to increase in income. Although this proportion fell in the past 15 years, sugar added to processed food doubled, especially in terms of consumption of soft drinks and cookies. **Conclusions:** Brazilians consume more sugar than the recommended levels determined by the WHO and the sources of consumption of sugar have changed significantly.

Keywords: Sugar. Add sugar. Sugar industry. Brazil. Household Budget Survey.

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Resumo

Objetivos: Estimar o consumo de “açúcar de adição” pela população brasileira, nos estratos regionais e socioeconômicos, destacando suas principais fontes alimentares e verificar a tendência do seu consumo nas últimas décadas. **Métodos:** Contou-se com informações das Pesquisas de Orçamentos Familiares a partir da década de 80 sobre o tipo e a quantidade de alimentos e bebidas adquiridos pelas famílias brasileiras. Os indicadores analisados foram: % das calorias de açúcar no total calórico da dieta e % calórico das frações de açúcar de mesa e de açúcar adicionado aos alimentos pela indústria/kcal açúcar da dieta. **Resultados:** Em 2002/03, 16,7% das calorias totais eram provenientes de “açúcar de adição” e sua participação mostrou-se elevada em todos os estratos regionais e de renda. A razão açúcar de mesa/açúcar adicionado pela indústria se inverte com o aumento da renda. A participação do açúcar de mesa nos últimos 15 anos foi reduzida, enquanto a contribuição do açúcar adicionado aos alimentos dobrou, especialmente por meio do consumo de refrigerantes e biscoitos. **Conclusões:** O consumo de açúcar no Brasil excede largamente a recomendação da OMS e verificou-se importante alteração nas fontes de consumo.

Palavras-chave: Açúcar. Açúcar adicionado. Indústria do açúcar. Brasil. Pesquisa de Orçamentos Familiares.

Introduction

The chemical definition of “sugars” refers to a group of compounds comprised of carbon, hydrogen and oxygen atoms, subdivided into monosaccharides – such as glucose, fructose and galactose – and disaccharides – such as sucrose (glucose and fructose) and lactose (glucose and galactose)¹. From the point of view of their effect on health, two types of sugar should be emphasized: those naturally found in foods, such as fructose and sucrose present in fruits and lactose present in milk; and those extracted from foods (sugarcane, beetroots and corn) for subsequent consumption in culinary preparations or in the manufacturing of processed foods. The latter group of sugars is known as added sugars². The present study will use the term “added sugars”.

While there are no evidences of health damages caused by the consumption of sugars naturally found in foods, there is growing evidence that the presence of added sugars in the diet is associated with the increase in the risk of several diseases, such as dental caries, obesity and other non-communicable chronic diseases. For this reason, the World Health Organization has established that the consumption of added sugars should not be higher than 10% of the total number of calories of the diet. There are several mechanisms that link the consumption of added sugars to health problems, including the erosion of dental enamel by acids resulting from bacterial metabolism of sugars^{1,3}; the impairment of the self-regulatory system of energetic balance (hunger/satiation), determined by either the increase in energy density of the diet or the energy consumption through sugar-sweetened beverages^{1,4-8}; and the increase in triglyceride concentration and decrease in high-density lipoprotein concentration^{9,10}. In addition, the high consumption of added sugars could be associated with a reduction in the protein and micro-nutrient contents in the diet¹¹⁻¹³.

There is little information available about the consumption of added sugars by

the population, particularly in developing countries. The present study aimed to estimate the consumption of added sugars in Brazil, to describe their main sources in the diet and their regional and socioeconomic distribution, and to establish their evolution in recent decades.

Methods

The data used in this study derived from the Household Budget Surveys (HBS) conducted by the *Instituto Brasileiro de Geografia e Estatística* (IBGE – Brazilian Institute of Geography and Statistics) in the following periods: between March 1987 and February 1988, between October 1995 and September 1996, and between June 2002 and July 2003. The last survey included a probabilistic sample of the entire country, when 48,470 households were studied (of which 13,848 were situated in metropolitan areas). In previous surveys, the probabilistic samples referred to the group of households from the metropolitan areas of Brazil (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba, Porto Alegre, Goiânia and Brasília), with 13,611 households studied in 1987/88 and 16,014 in 1995/96. The complex sample procedures used in the surveys have been thoroughly described in specific publications¹⁴⁻¹⁶.

The information about foods purchased by each household was obtained with the research collective spending booklet. In this booklet, all foods purchased during a period of seven consecutive days were recorded, including the amount, cooking measures with their equivalent metric measures in weight or volume, amount spent, place of purchase, and the way foods were obtained (through monetary or non-monetary means).

Researchers chose to adopt groups of households as unit of study, considering that the adequate characterization of the food purchase pattern in each household

studied could be compromised by the reduced number of days (a period of seven days) used to collect information about foods purchased by each household. Homogeneous households, according to their socioeconomic level and geographic location, were grouped into 443 strata (defined in the original sampling plan of the study) and used to describe the sugar consumption pattern in 2002/03. The mean number of households studied in each of the 443 strata of the 2002/03 HBS was 109.6 (varying between 9 and 804).

Information from the “*Sistema IBGE de Recuperação Automática* (SIDRA – IBGE Automatic Retrieval System)* had to be used to perform the analyses of sugar consumption trend in metropolitan areas, because the quantity (in grams) of each product purchased in each household were not available in the 1987/88 and 1995/96 surveys. The SIDRA provides detailed information about the purchase of foods and beverages, according to groups of households corresponding to ten intervals of income in each of the 11 areas surveyed, adding to 110 groups of households (units of study) in each one of the three periods studied (1987/88, 1995/96, 2002/03). The mean number of households surveyed in each of the 110 units originated from the samples of metropolitan areas was 123 in 1987/88 (varying between 45 and 351), 146 in 1995/96 (varying between 47 and 474) and 65.7 in 2002/03 (varying between 15 and 228). The weighting factor of each unit of study always resulted from the sum of sample weighting factors of households included in each unit in each survey.

Data analysis

The following indicators were constructed in the present study: percentage contribution of added sugars to the total amount of calories purchased; and the fraction of total sugar from “refined sugars and other

* IBGE. SIDRA (IBGE Automatic Retrieval System) Aggregated databases. Online. Available at: <http://www.sidra.ibge.gov.br/>. Accessed on March 22nd 2010.

caloric sweeteners” and “sugars added to processed foods by industries”.

First, the inedible fraction of the total amount in grams of each food obtained by households was excluded, when necessary, by applying correction factors recommended by the IBGE.** The quantity of each food was subsequently converted into calories using the *Tabela Brasileira de Composição de Alimentos* (TACO – Brazilian Food Composition Table), version 1***, or the official US Food Composition Table, version 15****, when a certain food was not available in the Brazilian table. Daily per capita energy availability was obtained by converting weekly records of purchase of foods of each unit of study into calories, adding up the total number of records and dividing the result by the sum of individuals in each unit of study. In the specific case of conversion of calories from added sugars, the calculation involved the following two steps: conversion of amounts (in grams) into calories from carbohydrates (using the TACO table whenever possible); and conversion of calories from carbohydrates into the corresponding calories from added sugars (using the American table, as the Brazilian table does not include details about the types of carbohydrates of each food).

Both “refined sugar and other caloric sweeteners” and “sugar added to processed foods by industry” were considered to calculate the calories from added sugars. Other caloric sweeteners included *rapadura* (a type of candy made from sugarcane juice), molasses, honey, corn syrup and fructose. The remaining sugars naturally found in foods, such as fructose in fruits and lactose in milk, were considered as part of the remaining calories not coming from added sugars.

Based on the 2002/03 HBS, the mean daily per capita availability of “added

sugars” (and respective confidence intervals) was estimated for the entire country and for the five Brazilian regions, divided into urban and rural areas, in addition to quintiles of per capita income distribution.

The percentage distribution of foods selected in the total household availability of “added sugars” was described for the country and according to quintiles of per capita income distribution. For this purpose, the foods purchased by families were divided into two source groups: 1) “refined sugar (sucrose) and other caloric sweeteners” and 2) “sugar added to foods processed by industry”.

The time trend analysis of “added sugars” consumption indicators was only performed for the households surveyed by the HBSs in metropolitan areas of Brazil, in 1986/87, 1995/96 and 2002/03.

All analytical procedures of this study were conducted with STATA, version 9.2, considering the sample design of the HBSs.

Ethical aspects

Authors declared there were no conflicts of interest, whether real, potential or apparent. In addition, the present study used secondary data collected from the IBGE, available for public online consultation. Thus, it was not necessary to submit it to any research ethics committees, according to a resolution of the *Comissão Nacional de Ética em Pesquisa* (CONEP – National Research Ethics Committee).

Results

The contribution of added sugars to household food availability in Brazil reached 16.7% of total calories, higher than the maximum limit of 10% recommended by the WHO. Except for the Northern region,

*[IBGE]. Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics). *Estudo Nacional da Despesa Familiar 1974/75* (ENDEF – National Study on Household Spending). Rio de Janeiro: IBGE; 1978.

***[NEPA/UNICAMP]. Núcleo de Estudos e Pesquisas em Alimentação/ Universidade Estadual de Campinas (UNICAMP – Center for Studies and Research on Diet). *Tabela Brasileira de Composição de Alimentos* (TACO – Brazilian Food Composition Table): Version 1. Campinas, São Paulo: NEPA/UNICAMP; 2004.

****United States Department of Agriculture. Agricultural Research Service. USDA National Nutrient Database for Standard Reference. Release 15. Beltsville; 2002

where added sugars corresponded to 13% of the total number of calories, the percentage of calories from added sugars was between 16.3% and 18.1% in all regions. There were no substantial differences between urban and rural households (Table 1).

The percentage of calories from added sugars was high (always above 15%) in all income groups and no linear relationship between the contribution of added sugars and household income level was found (Table 2).

In the set of Brazilian households, three quarters of calories from added sugars come from “refined sugars and other caloric sweeteners” (with a very small proportion of other caloric sweeteners – less than 0.6% of the total number of calories). The remaining quarter of calories from added sugars come from processed foods, especially sodas, candies, toffees, chocolate and cookies (Table 3). The proportion of added sugars coming from processed foods increased with the household income, becoming similar to

Table 1 - Availability of total energy and energy from added sugars in Brazilian households by region and urban or rural status (2002/03).

Tabela 1 - Disponibilidade calórica total e proveniente de “açúcares de adição” nos domicílios brasileiros segundo região e situação urbana ou rural (2002/03).

Region/ household status	Availability total (Kcal/p*/day)			Availability of added sugars (kcal/p/day)			% contribution of added sugars to the total energy value (% kcal sugar/ total kcal)		
	Mean	95%CI		Mean	95%CI		Mean	95%CI	
North									
Urban	1,693.0	1,572.6	1,813.4	208.5	191.1	225.9	13.3	12.4	11.1
Rural	2,488.1	2,327.3	2,649.0	283.7	236.2	331.3	13.6	11.5	9.5
Total	1,882.8	1,735.3	2,030.3	226.4	205.6	247.2	13.0	12.2	11.3
Northeast									
Urban	1,658.1	1,604.5	1,711.7	260.4	246.4	274.5	16.4	15.7	15.1
Rural	2,034.0	1,931.0	2,136.9	320.2	297.4	343.1	17.0	15.9	14.8
Total	1,757.0	1,696.2	1,817.8	276.2	263.1	289.2	16.3	15.8	15.2
Southeast									
Urban	1,708.0	1,585.9	1,830.1	297.0	263.2	330.9	18.1	17.1	16.1
Rural	2,550.3	1,934.3	3,166.2	437.2	349.5	525.0	19.4	17.6	15.9
Total	1,775.6	1,651.0	1,900.2	308.3	276.9	339.7	18.1	17.1	16.2
South									
Urban	1,795.7	1,666.1	1,925.3	281.3	261.1	301.5	16.5	15.7	14.9
Rural	2,888.1	2,417.9	3,358.3	434.9	361.6	508.2	16.9	15.4	13.8
Total	1,973.6	1,796.9	2,150.2	306.3	278.7	333.9	16.3	15.6	14.9
Center-West									
Urban	1,607.9	1,514.6	1,707.3	257.0	244.2	269.8	16.9	16.1	15.3
Rural	2,521.3	2,251.8	2,790.8	394.6	323.5	465.8	17.3	15.4	13.5
Total	1,714.9	1,596.7	1,833.1	273.1	253.9	292.4	16.7	16.0	15.3
Brazil									
Urban	1,702.6	1,637.2	1,767.9	278.4	259.6	297.2	16.8	16.2	15.6
Rural	2,375.5	2,171.7	2,579.2	368.0	335.2	400.8	16.5	15.8	15.0
Total	1,805.2	1,739.1	1,871.2	292.0	275.9	308.2	16.7	16.2	15.6

* per capita

Table 2 - Availability of total energy and energy from added sugars in Brazilian households by fifths of per capita income (2002/03).

Tabela 2 - Disponibilidade calórica total e proveniente de "açúcares de adição" nos domicílios brasileiros segundo quintos de renda per capita (2002/03).

Quintiles of income	"Added sugar" (kcal/p*/day)			"Added sugar" (% kcal sugar/ total kcal)			Calories (Kcal/p/day)		
	Mean	95%CI		Mean	95%CI		Mean	95%CI	
1 st	282.3	264.7	299.9	15.4	14.6	16.2	1,856.0	1,754.9	1,957.0
2 nd	305.7	270.0	341.8	16.1	15.1	17.1	1,899.9	1,731.8	2,068.0
3 rd	330.5	282.6	378.5	17.6	15.8	19.3	1,865.8	1,687.2	2,044.4
4 th	266.3	233.7	298.8	15.8	15.1	16.5	1,676.8	1,499.4	1,854.2
5 th	276.6	256.9	296.3	15.9	15.2	16.6	1,725.9	1,637.3	1,814.6

the proportion coming from "refined sugars and other caloric sweeteners" in the highest quintile of income (42.1% and 57.9%, respectively) (Table 3).

The evolution of contribution of added sugars to household food availability in Brazil can only be studied in metropolitan areas. The HBSs conducted in these areas in 1987/88, 1995/96 and 2002/03 show the stability of contribution of added sugars to total calories: 15.9%, 16.1% and 16.3%, respectively (p-value for trend of 0.407). However, the proportion of added sugars from processed foods significantly increases throughout the three surveys, doubling between 1987/88 and 2002/03 (from 17.4% to 35.5%). During this period, the contribution of sodas to total added sugars increased

200% (from 6.1% to 18.8%) and the contribution of cookies increased 100% (from 2.3% to 5.2%). The contribution of candies, toffees and chocolate also increased during this period, although without statistical significance.

Discussion

The results of the present study revealed an excessive consumption of added sugars in Brazilian households, higher than 60% of the maximum limit of consumption recommended by the WHO. This situation was observed in all Brazilian regions, in both urban and rural e areas and in all income groups. In metropolitan areas, the contribution of added sugars to the total number

Table 3 - Distribution (%) of the availability of energy from added sugars in households, by fifths of per capita income, according to food source (2002/03).

Tabela 3 - Distribuição (%) da disponibilidade de calorias oriundas de "açúcares de adição" nos domicílios brasileiros, por quintos de renda per capita, segundo alimentos fonte (2002/03).

Food sources of sugar	Brazil	Quintiles of income				
		1 st	2 nd	3 rd	4 th	5 th
Refined sugar and other caloric sweeteners	75.0	88.4**	82.6	78.4	67.5	57.9
Sugars	25.0	11.6**	17.4	21.6	32.5	42.1
in sodas	11.0	4.4**	7.8	9.6	15.3	18.0
in candies, toffees and chocolate	8.4	3.1**	5.4	7.0	11.1	15.4
in cookies	4.2	3.5**	3.4	4.0	4.4	5.5
in other foods*	1.5	0.6**	0.8	1.0	1.8	3.3

* sweetened breakfast cereals, milk beverages, teas and natural fruit juices. / * cereais matinais, bebidas lácteas, chás e sucos de frutas naturais adoçados
 ** significant p for linear trend** / p significativo para tendência linear

Table 4 - Distribution (%) of the availability of energy from added sugars according to food source. Metropolitan areas of Brazil (1987-2003).

Tabela 4 - Distribuição (%) da disponibilidade de calorias oriundas de "açúcares de adição", segundo alimentos fontes. Áreas metropolitanas do Brasil (1987-2003).

Food source	Survey years		
	1987/88	1995/96	2002/03
Refined sugar and other caloric sweeteners	82.6**	78.9	64.5
Sugars	17.4**	21.1	35.5
in sodas	6.1**	10.0	18.8
in candies, toffees and chocolate	8.3	7.1	10.1
in cookies	2.4**	3.5	5.2
in other foods*	0.6**	0.5	1.4

* sweetened breakfast cereals, milk beverages, teas and natural fruit juices / * cereais matinais, bebidas lácteas, chás e sucos de frutas naturais adoçados

** significant p for linear trend / ** p significativo para tendência linear

of calories of household food availability in Brazil remained practically stable between 1987/88 and 2002/03, although there was a substantial increase in the proportion of sugar calories from processed foods.

Evidence points to an increase in consumption of added sugars in recent decades, both in developed and certain developing countries, partly due to the changes in standard of living resulting from urbanization and increase in income. Between 1962 and 2000, the daily per capita consumption of added sugars increased by approximately 74 g¹⁷.

Considering exclusively the period analyzed in this study, between 1987 and 2003, data from Food Balance Sheets compiled by the United Nations Food and Agriculture Organization – FBS/FAO, which express the mean quantity of food available for human consumption in each country – indicate that the participation of added sugar on total calories available in developed countries varied slightly, from 16.5% to 17.1% in the United States and from 10.9% to 11.3% in the European Union countries. However, larger changes were seen in developing countries, such as Central America and the Caribbean countries and Brazil, where the intake, during the same period, changed from 15.1% to 18.1% and from 13.2% to 17.6% of total calories, respectively¹⁸.

The small variation in sugar consumption observed in developed countries could be associated with the saturation of the market, dissemination of information linking diseases to an excessive consumption of sugars and reduced variation in the price of demand in these countries¹⁹. In 2005/06, FAO data indicated that the availability of sugar in developed countries was approximately half of that observed in developing countries¹⁸.

The present study identified important changes in the contribution of the several dietary sources of added sugars to its total intake throughout time. The ratio between the contribution of table sugar and industrially added sugar suffered a massive reduction (4.7 against 1.8 times). Thus, the proportion of sugar from sodas, candies, toffees, chocolate and cookies, which represented approximately 17% of the total dietary sugar in the end of the 1980s, doubled (35%) in 2002/03.

Although the literature includes no information that permits researchers to compare changes in the contribution of sugar added to processed foods, product by product, throughout the decades, the situation found in Brazil appears to be similar to that of countries such as the United States, despite table sugar being the main source of sugar consumption. In the United States, the contribution of other types of sugar

specifically used in the manufacturing of processed foods has substantially grown in 35 years, to the detriment of refined sugar^{20,21}.

In Brazil, the greater contribution of processed foods to the increase in income level (varying between 11.6% and 42.2% between the lowest and highest quintiles of income distribution) could be an indication of changes in sources of sugar consumption, as there was a mean increase of 28.2% in the mean income of Brazilians between 2003 and 2008^{22,23}.

In fact, the substantial increase in consumption of sodas should be emphasized, as this high consumption is associated with a lower quality of diet and higher risks of development of non-communicable chronic diseases, such as type 2 diabetes²⁴⁻²⁷.

In addition, evidence suggests that calories consumed through liquids have a lower level of satiation when compared to those consumed through solid foods^{28,29}, resulting in an imbalance in organic self-regulatory mechanisms of food consumption and, consequently, excessive weight gain.

Although the increase in the contribution of manufactured foods to sugar consumption has not led to an increase in total dietary sugar, there is evidence associating the consumption of sugar from such source with greater contribution of fats and saturated fatty acids and lower contribution of carbohydrates other than sugar to the diet, whereas no association was found for table sugar³⁰.

The results of the present study only refer to the purchase of foods and beverages for domestic consumption. In Brazil, foods and beverages purchased for domestic consumption represented approximately 78% of total spending on food by families in 2002/03³¹. Assuming that the price per calorie of foods purchased for consumption out of the home is equal to or higher than the price of foods purchased for domestic consumption, the results of the present study could be applied to at least $\frac{3}{4}$ of the total number of foods purchased. In addition, the

possible effect of food consumption out of the home was reduced, showing estimates of sugar availability adjusted for the total number of calories purchased (percentage of contribution of calories from sugar to the total caloric value of the diet).

The short period of reference (one week) to collect data on the purchases of foods made for each household in the HBSs could equally be an important limitation to this study. Aiming to minimize this effect, researchers adopted groups of homogeneous households, according to their location and socioeconomic characteristics, as unit of analysis and studied them during a period of 12 months.

Despite these limitations, studies comparing data from household budget surveys with those obtained from individual consumption questionnaires point to a substantial level of agreement between methods^{32,33}. In the specific case of sugar consumption, a study conducted in four European countries estimated the correlation coefficient between sugar consumption measured by household budget surveys and that measured by individual consumption questionnaire to be 0.74³². Finally, data on household availability of sugars are sometimes considered to be a good approximation of consumption of such nutrient, as Household Budget Surveys can accurately reflect individuals' actual consumption in the case of foods used as ingredients in preparations, probably due to their difficulty in reporting the amount of foods consumed as part of a preparation in traditional food consumption questionnaires³⁰.

The high consumption of sugar in the Brazilian population, found in all contexts studied, largely exceeds the international recommendations, thus emphasizing the need for interventions aimed at its reduction. Considering the fact that sugar from processed foods has replaced table sugar as its main source of consumption in recent decades, interventions performed with food companies that seek to promote healthy eating habits become of utmost importance.

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Received: 03/03/11
Final version: 03/09/11
Approved: 17/10/11