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Caloric Beverages Were Major Sources of Energy among Children and Adults in Mexico, 1999–2012[1–3]

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Abstract

Mexico, with 1 of the highest obesity prevalences in the world, instituted a 10% excise tax for any sugar-sweetened beverage (SSB) starting on 1 January 2014. Understanding the recent patterns and trends in beverage intake and sales in Mexico provides both background and baseline data for the importance of SSBs and other beverages in the Mexican diet. We analyzed a single 24-h dietary recall from 2 nationally representative surveys: the Mexican Nutrition Survey 1999 (n = 6049) and the National Health and Nutrition Survey 2012 (n = 10,343). To describe trends and patterns in beverages, we calculated the volume and energy intake per capita and per consumer and the proportion of consumers of each beverage group in each survey. A commercial sales dataset was used to describe beverage sales trends from 1999 to 2012. From 1999 to 2012, total daily energy from beverages increased among children aged 5–11 y (+45.3 kcal), females aged 12–19 y (+57.3 kcal), and adult females aged 20–49 y (+96.4 kcal) ($P < 0.05$). Over the same period, intake of beverages with added sugars increased, specifically flavored milk, agua fresca (fruit water made in stalls or at home, usually with added sugars), and fruit drinks among children aged 5–11 y and females aged 12–19 y and caloric coffee/tea, soda, and agua fresca among adult females aged 20–49 y. In 2012, beverages represented 17.5% (325 kcal) and 19.0% (382 kcal) of the total daily energy intake per capita in children aged 1–19 y and adults aged ≥20 y, respectively. In 2012, flavored milk beverages, caloric soda, and high-fat milk were the top 3 major contributors to total daily energy intake per capita in all children aged 1–19 y. Caloric soda, caloric coffee/tea, and agua fresca were the top 3 major energy contributors in adults aged ≥20 y. From 1999 to 2012, sales of soda, fruit-flavored drinks, and flavored waters increased. In conclusion, consumption of several beverages with added sugars increased among children and adult females in Mexico. Because caloric soda is currently 1 of the top beverages consumed, a 10% tax on SSBs might help to significantly reduce added sugars intake in Mexico. J. Nutr. 144: 949–956, 2014.

Introduction

Mexico has 1 of the highest prevalences of childhood and adult overweight and obesity in the world. In the past 7 y, the government implemented a number of policies and programs to slow the increasing obesity prevalence in Mexico. In 2008, the Ministry of Health established an expert panel to develop recommendations on beverage intake for a healthy life (1). Based on this report, the government made extensive changes in its social assistance programs to reduce full-fat milk to 1.5% milk. In 2010, the government began an initiative that ultimately led to removing sales of soda from all schools (although children can bring their own from home) (2) and, in January 2014, instituted a 10% excise tax on any beverage containing added sugars, with the exception of milk.

A substantial body of literature highlights the health consequences of high sugar-sweetened beverage (SSB)[6] intake among children and adults (3,4). Findings from both large observational studies and randomized clinical trials support a link between SSB consumption and weight gain, as well as an association between SSB consumption and a variety of cardiometabolic problems (3–9). The expectation is that the implementation of the tax will result in a reduction in consumption of SSB.

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[3] Supplemental Tables 1–10 are available from the "Online Supporting Material" link in the online posting of the article and from the same link in the online table of contents at http://jn.nutrition.org.
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[6] Abbreviations used: MNS 1999, Mexican Nutrition Survey 1999; NHNS 2012, National Health and Nutrition Survey 2012; RTD, ready-to-drink; SES, socioeconomic status; SSB, sugar-sweetened beverage.

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Therefore, it is important to understand changes and patterns of SSB consumption in Mexico before the implementation of the excise tax. Moreover, as a result of the tax, people may compensate by increasing the consumption of other type of beverages. Therefore, it is also important to understand changes and current patterns of consumption on the whole spectrum of beverage consumption (caloric and noncaloric), including agua fresca (fruit water made in stalls or at home, usually with added sugars), milk, and plain water.

Although previous studies using earlier Mexican nutrition surveys showed that caloric intake from SSBs doubled in Mexico between 1999 and 2006 across all age groups (10,11), these studies compared national surveys that used different methodologies to collect dietary data. Therefore, changes in consumption over time may reflect both true changes and differences in the methodology used. Both the Mexican Nutrition Survey in 1999 (MNS 1999) and the National Health and Nutrition Survey in 2012 (NHNS 2012) used 24-h recalls to collect dietary intake data. In the present study, we used these 2 surveys to describe trends in beverage consumption from 1999 to 2012 in children and women of childbearing age. Furthermore, using the NHNS 2012 survey, we analyzed current patterns of beverage intake in adults and children. Finally, we describe trends in beverage sales using commercial data from 1999 to 2012.

Participants and Methods

Study design and sample

The MSN 1999 and the NHNS 2012 are nationally representative, cross-sectional, multistage, stratified surveys with sampling power to disaggregate by geographic region and by rural (population <2500 inhabitants) and urban (population > 2500 inhabitants) areas. The main objective of these surveys was to characterize the health and nutritional status of the Mexican population (12,13). The sampling system of the NHNS 2012 was drawn to be representative of all states and 4 regional strata with common geographic and socioeconomic status (SES) characteristics. Because of budget restrictions, the MSN 1999 was only drawn to be representative of the 4 regional strata: *1*) North (Baja California, Baja California Sur, Coahuila, Chihuahua, Durango, Nuevo León, Sonora, and Tamaulipas); *2*) Center (Aguascalientes, Colima, Estado de México, Guanajuato, Jalisco, Michoacán, Morelos, Nayarit, Querétaro, San Luis Potosí, Sinaloa, and Zacatecas); *3*) Mexico City and metropolitan area; and *4*) South (Campeche, Chiapas, Guerrero, Hidalgo, Oaxaca, Puebla, Quintana Roo, Tabasco, Tlaxcala, Veracruz, and Yucatán).

The MNS 1999 was conducted from October 1998 to March 1999 and surveyed 21,503 Mexican households, with a household response rate of 82.3%. Because of budget restrictions, it only collected information of preschoolers (aged 1–4 y), school age children (aged 5–11 y), and women of childbearing age (aged 12–49 y) (13,14). The NHNS 2012 was conducted from October 2011 to May 2012 and surveyed 50,528 Mexican households, with a household response rate of 87.0% (12,15). The NHNS 2012 collected data on all age groups and both genders. We analyzed a total of 6049 individuals from the MNS 1999 and 10,343 individuals from the NHNS 2012 with complete dietary data.

Informed consent was obtained from each participant or participant's parent/guardian (assent was obtained for children aged ≥10 y). The survey protocol was approved by the Ethics Committee of the Mexican National Institute of Public Health.

Assessment of dietary intake in the MNS 1999 and NHNS 2012

In each survey, dietary intake was collected by trained interviewers using a single 24-h recall in a stratified subsample of the population (12,14). Respondents reported all foods and beverages consumed in the previous 24-h time period. This methodology is considered adequate to study the mean consumption of foods, energy, and nutrients in population studies (16). During the interview, participants were asked to report consumption of foods, dishes (or preparations), and beverages, as well as the amount consumed, from foods consumed away from home and/or prepared at home. For foods prepared at home, participants were asked to report the detailed recipe. Additionally, participants were asked about food and beverages consumed between principal meals, both inside and outside the home. Each interviewer was provided with a manual with photos of commonly consumed foods, a food scale, measuring cups, and serving spoons of various sizes to help in estimating the amount of food or beverages (in grams or milliliters) reported by each participant. The main meal planner was asked to report dietary intake for children younger than 12 y. Only in the NHNS 2012 was an automated 5-step multiple-pass method implemented to improve dietary recall. The MNS 1999 collected dietary data from weekdays only, whereas the NHNS 2012 collected data from both weekdays and weekend days.

To capture current changes in the Mexican food supply, we used the 2012 food composition table, which was based on a combination of the nutrient composition analyses conducted in Mexico on some unique foods and the food composition tables from the USDA Food and Nutrient Database for Dietary Studies (17,18).

Beverage grouping system

Consistent with previous beverage classification systems (19), we grouped all beverages using their food description or their energy density (kcal/100 mL), although the majority of beverages were classified using keyword searches at their food description. We first combined beverage ingredients that were recorded separately into a single beverage group (i.e., coffee, milk, and sugar as parts of a single preparation were combined into a single group called "coffee with milk and sugar"). Beverages were first grouped into 10 broad groups: *1*) water; *2*) agua fresca; *3*) coffee/tea; *4*) soda; *5*) fruit and vegetable beverages; *6*) milk and milk beverages; *7*) atole (cornstarch beverage); *8*) sports and energy drinks; *9*) alcoholic beverages; and *10*) other beverages (**Supplemental Table 1**). Sodas were further divided into "caloric" and "low calorie" groups using keyword searches (i.e., soda was classified as low calorie if the food description indicated that the beverage was "light" or "low calorie"). Other beverages, such as coffee/tea with milk and/or added sugars, were classified as caloric or low calorie using their energy density (i.e., beverages with <20 kcal/100 g were considered low calorie; otherwise, they were classified as caloric). When possible, beverages with added sugars were separated into individual beverage groups, except when a specific beverage group was barely consumed by the population. We finally classified all beverages into 17 specific groups that represent all beverages consumed by the Mexican population.

Sociodemographic variables

SES index. In the MNS 1999, an SES index was created using principal component analysis based on household and community characteristics (i.e., household flooring material, potable water, and ownership of electrical home appliances, including washing machine, refrigerator, television, radio, and stove) (20). In the NHNS 2012, the SES index was generated by imputing deciles of income level to the households using demographic and SES variables (i.e., characteristics of the head of household, demographic household structure, home characteristics and appliances, household expenditure, and level of marginalization of the geographic area) and was based on the National Income and Expenditure Survey 2010 (21). In each survey, the SES index was divided into tertiles and used as a proxy for low, medium, and high SES.

Age groups. Different age groups were created: *1*) 1–4 y; *2*) 5–11 y; *3*) 12–19 y; *4*) 20–59 y; and *5*) ≥60 y. Analyses were performed for children (aged 1–19 y) and adults (aged ≥20 y) and for each age and gender subpopulation in the NHNS 2012. For the MNS 1999, groups were created for males and females aged 1–4 and 5–11 y and for females aged 12–19 and 20–49 y.

Sales data

The Passport Global Market of Euromonitor International is an independent market analysis company that provides information on industry sales per year (22). Euromonitor International reports compile

data using national-level desk research, store checking, trade interviewing with national players, company analysis, forecast, data validation, market analysis, and multinational research and analysis. These data were used by scholars in nutrition and other fields to study tobacco, alcohol, and processed foods (23–25). Euromonitor International represents aggregate sales at the year level and is not linked to individuals.

We collected data for total volume sales for selected ready-to-drink (RTD) beverage categories from 1999 to 2012 (22). Beverages were grouped into 9 groups: *1*) regular cola carbonates; *2*) non-cola carbonates; *3*) low-calorie cola carbonates; *4*) flavored bottled water; *5*) fruit-flavored drinks (0% juce); *6*) nectar and juice (25–100% juice); *7*) 100% juice *8*) sports and energy drinks; and *9*) RTD coffee and tea (Supplemental Table 1). Total volume sales include on-trade and off-trade volume sales. Off-trade sales refer to sales from retail locations, such as supermarkets and convenient stores. On-trade sales include sales through bars, restaurants, and cafes. In Mexico, Euromonitor International does not capture 1 set of beverages typically sold by street vendors, with freshly prepared agua fresca being the most important one.

Statistical analysis

All analyses were performed using Stata 13 (StataCorp). Survey commands were used to account for survey design and weighting to generate nationally representative results.

We first estimated trends in beverage consumption from 1999 to 2012. For each beverage group, we calculated the proportion of consumers, the mean total daily volume (milliliters) per capita and per consumer, and the mean total daily energy intake (kilocalories) per capita and per consumer. Per-capita estimates were calculated for the entire population of consumers and nonconsumers of the different beverage groups, whereas per-consumer estimates were calculated using consumption (milliliters or kilocalories) only among consumers in the population. These trends were obtained for males and females aged 1–4 and 5–11 y and for females aged 12–19 and 20–49 y, because these age groups were consistently captured in both surveys.

Second, we described current patterns of beverage consumption using the NHNS 2012. Similarly, we estimated the proportion of consumers, the mean total daily volume (milliliters) per capita and per consumer, and the mean total daily energy intake (kilocalories) per capita and per consumer. The contribution of each beverage group to the total energy intake was calculated by dividing the energy intake (per capita and per consumer, in kilocalories) from each beverage group by the mean total energy intake per day. Estimates for dietary trends and patterns are presented as means ± SEs. Statistically significant differences were tested using Student's *t* test with the Bonferroni's correction for multiple comparisons. A 2-sided P value of 0.05 was set to denote statistical significance.

Finally, we describe trends in sales using Euromonitor International data from 1999 to 2012. We extracted the number of liters sold per year by beverage category and calculated the per-capita volume of sales per day (milliliters per day) using the Mexican population size as reported census.

Results

Sociodemographic characteristics. The population distributions of the MNS 1999 and NHNS 2012 by SES characteristics are presented in **Table 1**. Because of its selection criteria, the MNS 1999 included a higher proportion of females and children aged 1–4 and 5–11 y than the NHNS 2012. Both the MNS 1999 and NHNS 2012 had a higher proportion of participants from urban areas and from a higher socioeconomic level.

Trends in consumption from 1999 to 2012. Trends in beverage consumption (per capita, per consumer, and percentage consumers) from 1999 to 2012 in each age group are shown in **Figure 1** and **Supplemental Tables 2–5**. Overall, total daily energy intake increased in all age groups from 1999 to 2012 (Supplemental Tables 2–5). Over the same period, total daily energy from beverages increased significantly only among children aged 5–11 y (+45.3 kcal), females aged 12–19 y (+57.3 kcal), and adult females aged 20–49 y (+96.4 kcal). The per-capita contribution of energy from beverages (kilocalories per day) to total daily energy intake decreased significantly among children aged 1–4 y (27.5% in 1999 vs. 23.9% in 2012, $P < 0.05$).

TABLE 1 Sociodemographic characteristics of the MNS 1999 and NHNS 2012[1]

	MNS 1999	NHNS 2012
	n (%)	*n (%)*
Total population	6049 (100)	10,343 (100)
Gender		
Male	1838 (26)	4946 (48)
Female	4140 (74)	5397 (52)
Age (y)		
1–4	1168 (20)	2207 (8)
5–11	2464 (30)	2751 (16)
12–19	435 (9)	2113 (15)
20–59	1982 (41)	2255 (49)
≥60	N/A	1017 (11)
Area		
Urban	3534 (72)	6445 (73)
Rural	2264 (28)	3898 (27)
Geographic area		
North	1693 (19)	2450 (20)
Central	1700 (33)	3783 (30)
Mexico City and metropolitan area	478 (16)	491 (18)
South	1784 (32)	3619 (32)
Socioeconomic Level		
Low	1962 (29)	3820 (31)
Medium	2011 (33)	3611 (32)
High	1939 (38)	2912 (37)

[1] Percentages were weighted to adjust for unequal probability of sampling and to be nationally representative. The MNS 1999 only included male and female children aged 1–11 y and women of reproductive age (12–19 and 20–49 y). The NHNS 2012 included males and females of all age groups. In the MNS 1999, sample sizes within some of the sociodemographic characteristics do not add up to the total sample size due to missing data. MNS 1999, Mexican Nutrition Survey 1999; N/A, not available; NHNS 2012, National Health and Nutrition Survey 2012.

Regarding beverage groups, the consumption of agua fresca and fruit/vegetable juice and drinks increased whereas intake of plain high-fat milk decreased from 1999 to 2012 in children aged 1–4 and 5–11 y and females aged 12–19 y (Fig. 1). Over the same period, caloric soda and flavored milk beverage consumption increased in children aged 5–11 y. In adult females aged 20–49 y, intake of agua fresca, caloric coffee/tea, caloric soda, and flavored milk increased whereas high-fat milk intake decreased from 1999 to 2012.

The proportion of consumers of plain water and high-fat milk decreased from 1999 to 2012 among children aged 1–4 and 5–11 y and females aged 12–19 y, whereas the proportion of consumers of agua fresca and caloric soda markedly increased among children aged 5–11 y and females aged 12–19 y over the same time period. In females aged 20–49 y, the proportion of consumers of agua fresca, caloric coffee/tea, and flavored milk increased from 1999 to 2012 (Supplemental Tables 2–5).

Beverage consumption patterns among Mexican children in 2012. In 2012, the mean per-capita consumption of beverages was ~325 kcal/d among all children and adolescents aged 1–19 y

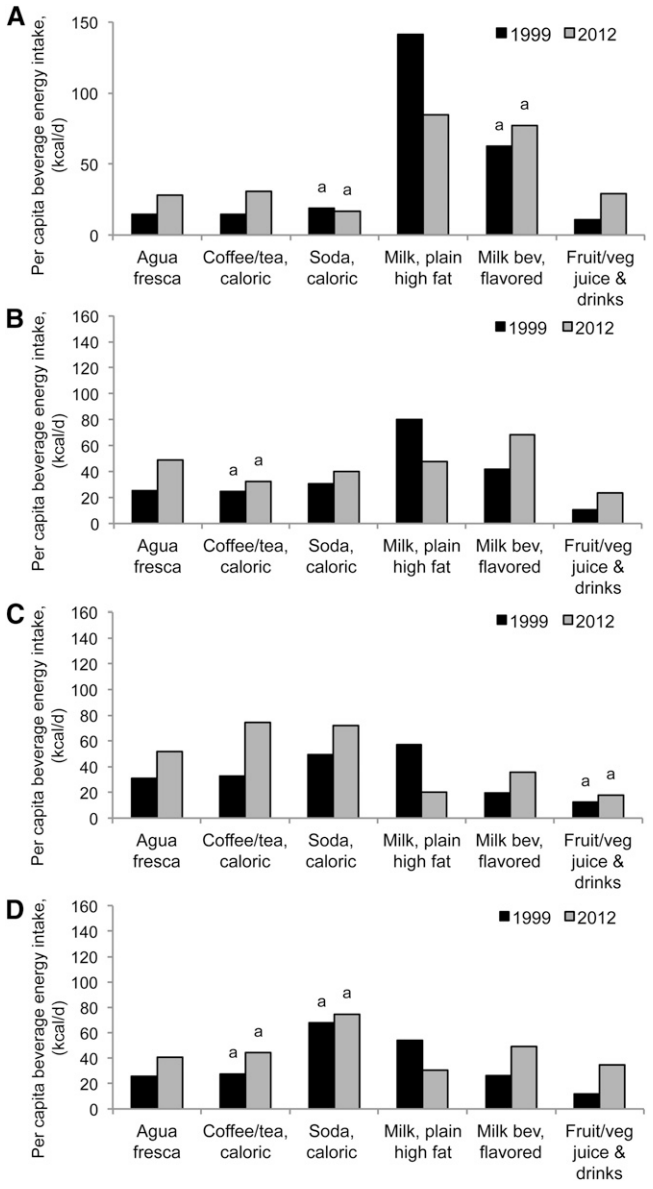

FIGURE 1 Trends in per-capita beverage consumption by age group comparing 1999 and 2012: children aged 1–4 y (*A*), children aged 5–11 y (*B*), females aged 12–19 y (*C*), and females aged 20–49 y (*D*). Values represent means; n = 429–2751. All data were derived from the Mexican Nutrition Survey 1999 (n = 6049) and the National Health and Nutrition Survey 2012 (n = 10,343). Estimates with a common letter do not differ, $P \geq 0.05$ (Bonferroni's-adjusted Student's t test). bev, beverage; veg, vegetable.

(**Table 2**). All beverages represent 17.5% of the total daily energy intake per capita. The top 3 most consumed beverages were plain water (72.8%), caloric soda (37.7%), and high-fat milk (26.3%). In terms of calories, flavored milk beverages, caloric soda, and high-fat milk were the top 3 major contributors to the per-capita total daily energy intake.

These same results are shown by age group in **Figure 2***A* and **Supplemental Tables 6–8**. On a per-capita basis, children aged 1–4 y consumed a mean of 810 mL/d of beverages, whereas those aged 5–11 y consumed 1040 mL/d and 12–19 y consumed 1400 mL/d of beverages. Beverages represented 22.1%, 16.6%, and 16.8% of the total daily energy intake among children aged 1–4, 5–11, and 12–19 y, respectively. Plain water was the top most consumed beverage among all age groups, followed by high-fat milk and flavored milk beverages among children aged 1–4 y, caloric soda and agua fresca among those aged 5–11 y, and caloric soda and caloric coffee/tea among those aged 12–19 y. The top 3 sources of energy intake were high-fat milk, flavored milk, and caloric coffee/tea among children aged 1–4 y, flavored milk, agua fresca, and high-fat milk among those aged 5–11 y, and caloric soda, flavored milk, and agua fresca among those aged 12–19 y. Adolescents aged 12–19 y had a significantly higher per-capita consumption of caloric soda (kilocalories per day) compared with younger children ($P < 0.05$) (Fig. 2*A*).

Few differences were found between male and female children aged 1–19 y (**Fig. 3***A*). Consumption of flavored water, caloric soda, and alcoholic beverages was significantly higher in males compared with females ($P < 0.05$).

Beverage consumption patterns among Mexican adults in 2012. In 2012, the mean per-capita consumption of beverages was ~382 kcal/d among adults aged ≥20 y (**Table 3**). All beverages represent 19.0% of the total daily energy intake per capita. The top 3 most consumed beverages were plain water (74.6%), caloric soda (42.0%), and caloric coffee/tea (37.6%). In terms of calories, caloric soda, caloric coffee/tea, and agua fresca were the top 3 major contributors to the total daily energy intake per capita.

Figure 2*B* and **Supplemental Tables 9 and 10** display these same results by age group. Beverages represented 19.2% and 17.8% of the total daily energy intake among adults aged 20–59 and ≥60 y, respectively. Plain water was the top most consumed beverage in these age groups, followed by caloric soda and caloric coffee/tea. The top 3 sources of energy intake were caloric soda, caloric coffee/tea, and agua fresca among adults aged 20–59 y and caloric coffee/tea, caloric soda, and agua fresca among adults aged ≥60 y. Adults aged 20–59 y had a significantly higher per-capita consumption of caloric soda and alcoholic beverages (kilocalories per day) compared with older adults ($P < 0.05$) (Fig. 2*B*).

Compared with female adults, males had a significantly higher consumption of caloric soda and alcoholic beverages ($P < 0.05$) (Fig. 3*A*). There were a higher proportion of consumers of plain water among female adults compared with males (Fig. 3*B*).

Trends in sales of selected beverage groups. Per-capita trends in sales (milliliters per day) from 1999 to 2012 in Mexico are shown in **Figure 4**. Since 1999, per-capita volume sales of regular cola carbonates increased from 228 to 269 mL/d, whereas non-cola carbonate sales increased from 86 to 103 mL/d. Regular cola carbonates contribute to the highest volume of sales in Mexico from 1999 to 2012. Sales of fruit-flavored drinks and juice drinks (<25% juice) nearly doubled over the same time period. Sales of low-calorie cola carbonates increased steadily whereas flavored bottled waters had the highest proportional increase in sales from 1999 to 2012.

Discussion

Among children aged 5–11 y and females aged 12–49 y, intake of caloric sugary beverages increased considerably over the 1999–2012 period in Mexico. Because data for male adults were not collected in the MNS 1999, it is unknown whether the same trends toward increasing caloric sugary beverages happened in this group. Among children aged 1–4 y, the contribution of beverages to total daily caloric intake decreased from 27.5% to 23.9% from 1999 to

TABLE 2 Daily beverage consumption among Mexican children aged 1–19 y, data from the NHNS 2012[1]

Beverage group	Consumers	Volume		Energy intake		Contribution to total energy intake	
		Per capita	Per consumer	Per capita	Per consumer	Per capita	Per consumer
	n (%)	*mL/d*		*kcal/d*		%	
Water							
Plain	5153 (72.8)	438 ± 10	601 ± 11	—	—	—	—
Flavored/caloric	330 (4.5)	19.2 ± 2.4	430 ± 26	5.2 ± 0.6	116 ± 7	0.3	6.2
Agua fresca (fruit water)	1630 (23.8)	131 ± 7	551 ± 18	42.8 ± 2.5	180 ± 8	2.3	9.7
Coffee and tea							
Caloric	1466 (21.7)	62.4 ± 2.9	287 ± 7	36.9 ± 2.1	170 ± 7	2.0	9.2
Plain/low calorie	782 (11.6)	41.4 ± 3.9	358 ± 29	3.6 ± 0.2	31 ± 2	0.2	1.7
Soda							
Caloric	2566 (37.7)	131 ± 5	348 ± 8	56.9 ± 2.0	151 ± 4	3.1	8.1
Low calorie	560 (8.3)	28.5 ± 3.7	342 ± 33	0.7 ± 0.2	65 ± 13	0.0	3.5
Fruit and vegetable beverages							
100% natural juice	216 (3.0)	10.6 ± 1.8	347 ± 41	4.6 ± 0.8	150 ± 19	0.2	8.1
Fruit/vegetable drinks	1513 (18.9)	54.9 ± 3.3	290 ± 12	24.1 ± 1.4	127 ± 5	1.3	6.9
Milk and milk beverages							
Plain, high fat	1892 (26.3)	85.7 ± 3.4	326 ± 6	49.6 ± 2.0	189 ± 4	2.7	10.2
Plain, low fat	142 (2.2)	6.9 ± 1.0	318 ± 21	3.0 ± 0.4	138 ± 10	0.2	7.4
Milk beverages, flavored	1634 (22.1)	81.0 ± 4.0	367 ± 12	65.0 ± 3.1	294 ± 9	3.5	15.8
Atole							
Milk-based	332 (4.3)	13.7 ± 1.4	317 ± 16	14.8 ± 1.4	343 ± 15	0.8	18.5
Water-based	279 (3.5)	12.3 ± 1.5	355 ± 21	8.4 ± 1.2	243 ± 22	0.5	13.1
Sports and energy drinks	36 (0.5)	3.1 ± 0.8	586 ± 59	0.8 ± 0.2	148 ± 16	0.0	8.0
Alcoholic beverages	41 (0.6)	8.8 ± 2.7	1400 ± 281	4.6 ± 1.2	725 ± 142	0.2	39.1
Other beverages	215 (3.3)	5.0 ± 0.8	150 ± 18	4.3 ± 1.1	130 ± 28	0.2	7.0
Total from beverages	7014 (99.2)	1130 ± 15	1141 ± 15	325 ± 5	347 ± 5	17.5	18.7
Total	7071 (100)	1990 ± 20	1990 ± 20	1860 ± 18	1860 ± 18	—	—

[1] Values are presented as sample size (%) and means ± SEs. Estimates were weighted to adjust for unequal probability of sampling and to be nationally representative. NHNS 2012, National Health and Nutrition Survey 2012.

2012. The most important shifts were the increase in beverages with added sugars, specifically flavored milk, agua fresca, and fruit drinks among children and adolescent females, and caloric coffee/tea, soda, and agua fresca among adult women. In 2012, 17.5% and 19.0% of the total daily caloric intake came from beverages among children aged 1–19 y and adults aged ≥20 y, respectively. Middle-aged children and adolescents had higher intakes of caloric soda and agua fresca, whereas children aged 1–4 y had higher intake of high-fat milk and flavored milk beverages. Adults aged 20–59 y had higher intakes of caloric soda compared with older adults aged ≥60 y. In line with previous reports on beverage consumption in Mexico (10,11), our results indicate that caloric sugary beverages are currently the top sources of calories from beverages in the Mexican population, and, consequently, added sugars from beverages are a cause of concern among all age and gender groups in Mexico.

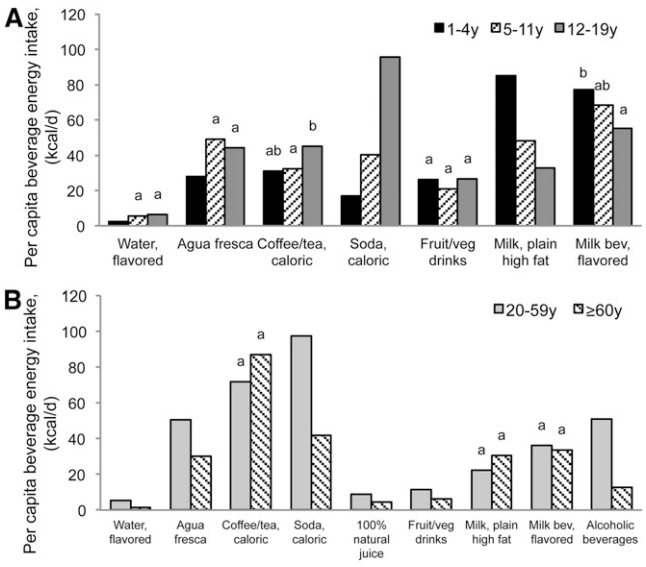

FIGURE 2 Per-capita beverage intake by age group: children aged 1–19 y (*A*) and adults aged ≥20 y (*B*). Values represent means; $n = 1017$–2751. All data were derived from the National Health and Nutrition Survey 2012 ($n = 10{,}343$). Estimates with a common letter do not differ, $P \geq 0.05$ (Bonferroni's-adjusted Student's *t* test). bev, beverage; veg, vegetable.

Our results are also similar to current patterns of beverage consumption in the United States. Over the past decade (26–28), the proportion of calories from beverages was higher (21.0%), and currently approximately half of daily added sugars intake comes from beverages (29–31). However, since the highest peak in SSB intake in 2001–2002, there have been important declines in caloric beverage consumption in the United States (22,32).

Although methodology differences exist between the MNS 1999 and NHNS 2012, which may overestimate the observed differences in beverage consumption between these surveys, we also documented an important increasing trend in sales of all categories of caloric beverages, such as regular cola carbonates, fruit drinks, juices, and flavored waters. Two previous studies on this topic used the MNS 1999 along with the NHNS 2006, which collected dietary intake using an FFQ (10,11). Although their dietary collection methods were not exactly comparable,

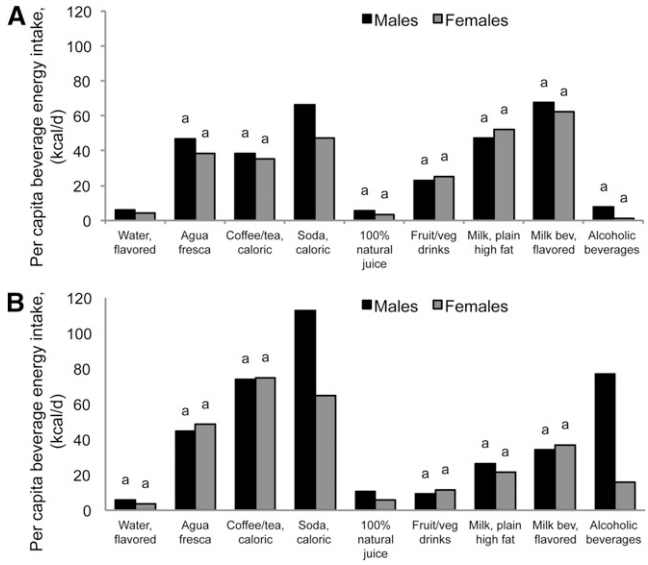

FIGURE 3 Per-capita beverage intake by age and gender: children aged 1–19 y (*A*) and adults aged ≥20 y (*B*). Values represent means; n = 1375–3571. All data were derived from the National Health and Nutrition Survey 2012 (n = 10,343). Estimates with a common letter do not differ, $P \geq 0.05$ (Bonferroni's-adjusted Student's t test). bev, beverage; veg, vegetable.

they reported an important increasing trend in caloric beverages in all age groups, with especially high intakes among adolescents and young adults. The NHNS 2006 reported a slightly higher contribution of caloric soda to total energy intake compared with the NHNS 2012, which could be explained by the differences in the dietary collection methods. By using the NHNS 2012, we were able to obtain comparable results with the MNS 1999 because both surveys used 24-h recalls to collect dietary intake. Another great advantage of the NHNS 2012 is that this survey collected very detailed information on plain water consumption, which was collected more accurately than in 1999, contributing to a smaller underestimation of total liquid consumption compared with the MNS 1999. Even if plain water consumption was collected more accurately in 2012 relative to 1999, our study showed that the proportion of consumers of plain water decreased from 1999 to 2012 in all age subgroups.

In the context of increased consumption of SSBs in Mexico, the recent 10% excise tax on all beverages with added sugars would be expected to lead to a reduction in SSB intake if SSB portion sizes decrease, products get reformulated, the beverage industry passes these taxes onto consumers by increasing beverage prices, or tax revenues are used to finance effective public health efforts to prevent obesity. Globally, there is a large literature indicating that SSBs are price sensitive, which suggests that increases in SSB prices may be linked with reduced SSB intake (33–35). Earlier studies conducted in Mexico suggested that beverage taxes would be associated with reduced SSB intake (11). Research has advocated a 20% excise tax, which is the amount that public health scholars and consumer federations in Mexico desired. Thus, the effect of the smaller 10% excise tax is unclear (36,37). One of the main issues will be what beverages are substituted for the SSBs whose prices are raised. In the only study in Mexico on this topic, milk intake increased when SSB prices were increased (11).

TABLE 3 Daily beverage consumption among Mexican adults aged ≥20 y, data from the NHNS 2012[1]

		Volume		Energy intake		Contribution to total energy intake	
Beverage group	Consumers	Per capita	Per consumer	Per capita	Per consumer	Per capita	Per consumer
	n (%)	*mL/d*		*kcal/d*		%	
Water							
Plain	2453 (74.6)	626 ± 17	840 ± 20	—	—	—	—
Flavored/caloric	97 (3.6)	16.9 ± 3.4	470 ± 36	4.6 ± 0.9	127 ± 9	0.2	6.3
Agua fresca (fruit water)	698 (21.9)	138 ± 10	630 ± 31	46.7 ± 3.8	213 ± 13	2.3	10.6
Coffee and tea							
Caloric	1201 (37.6)	129 ± 5	342 ± 8	74.6 ± 4.7	198 ± 11	3.7	9.9
Plain/low calorie	769 (22.9)	93.9 ± 6.0	410 ± 16	8.1 ± 0.6	35 ± 2	0.4	1.8
Soda							
Caloric	1304 (42.0)	201 ± 8	478 ± 14	87.0 ± 3.6	207 ± 6	4.3	10.3
Low calorie	247 (8.3)	34.4 ± 4.2	415 ± 37	1.3 ± 0.5	118 ± 47	0.1	5.9
Fruit and vegetable beverages							
100% natural juice	112 (4.1)	19.8 ± 2.5	482 ± 38	7.9 ± 1.1	192 ± 18	0.4	9.6
Fruit/vegetable drinks	217 (6.9)	23.3 ± 2.7	337 ± 17	10.5 ± 1.2	152 ± 7	0.5	7.5
Milk and milk beverages							
Plain, high fat	447 (13.2)	41.1 ± 3.6	311 ± 11	23.7 ± 2.1	180 ± 7	1.2	8.9
Plain, low fat	46 (1.2)	3.8 ± 0.9	307 ± 22	1.6 ± 0.4	131 ± 11	0.1	6.5
Milk beverages, flavored	387 (12.7)	50.4 ± 4.8	398 ± 28	35.6 ± 3.1	281 ± 17	1.8	14.0
Atole							
Milk-based	153 (4.5)	15.6 ± 2.0	345 ± 18	16.9 ± 2.3	374 ± 27	0.8	18.6
Water-based	174 (4.5)	21.4 ± 2.8	474 ± 36	15.4 ± 2.3	341 ± 34	0.8	16.9
Sports and energy drinks	18 (1.0)	5.7 ± 2.2	555 ± 118	1.4 ± 0.5	131 ± 30	0.1	6.5
Alcoholic beverages	189 (6.3)	75.4 ± 11.2	1200 ± 150	44.0 ± 6.8	698 ± 90	2.2	34.7
Other beverages	49 (2.0)	3.4 ± 0.7	174 ± 33	2.3 ± 0.6	116 ± 26	0.1	5.8
Total from beverages	3254 (99.4)	1500 ± 25	1510 ± 25	382 ± 10	403 ± 11	19.0	20.0
Total	3272 (100)	2440 ± 31	2440 ± 31	2010 ± 28	2010 ± 28	—	—

[1] Values are presented as sample size (%) and means ± SEs. Estimates were weighted to adjust for unequal probability of sampling and to be nationally representative. NHNS 2012, National Health and Nutrition Survey 2012.

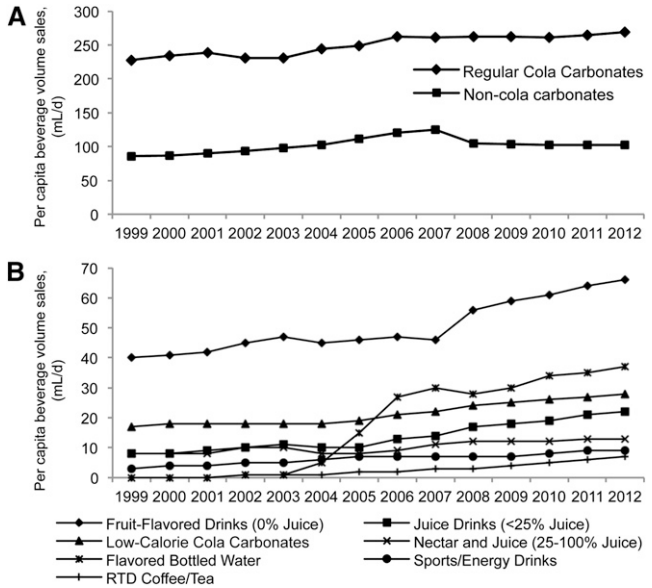

FIGURE 4 Trends in daily per-capita total volume sales, 1999–2012 for regular cola carbonates and caloric and noncaloric non-cola carbonates (*A*) and caloric and noncaloric other beverages (*B*). Values represent aggregate sales in volume and are not linked to individuals. All data were derived from the Passport Global Market of Euromonitor International. RTD, ready-to-drink.

The main strength of this study was that it provided a baseline measure of beverage consumption in the Mexican population before the initiation of the 10% excise tax on beverages with added sugars on 1 January 2014. There were also several limitations. Both the MNS 1999 and NHNS 2012 are cross-sectional observational datasets, and our analysis used self-reported intake data, which may be affected by measurement error. Additional research should investigate whether such measurement error is randomly distributed across the different age and gender subgroups or whether it systematically affects certain subpopulations. Most importantly, our estimates were based on a single 24-h dietary recall; therefore, it may not reflect usual intake or represent the general beverage consumption patterns for the respondents (i.e., no consumption of a given beverage group during 24-h period might not imply no consumption of that beverage group at all). Despite these limitations, these datasets are the most comprehensive nationally representative data for studying dietary intake in the Mexican population. Another limitation was that Euromonitor International only captures sales volumes, which is an imperfect measure of total beverage consumption because they do not include beverage products prepared at home or that are not RTD and it does not take into account wastage.

In summary, our study showed an increasing consumption trend in caloric soda and other caloric beverages with added sugars, such as agua fresca, caloric coffee/tea, and flavored milk beverages. Additionally, we showed an important increasing trend in sales of all categories of caloric beverages. Moreover, in 2012, flavored milk beverages, caloric soda, and high-fat milk contributed the most to total daily energy intake per capita in children. In adults, caloric soda, caloric coffee/tea, and agua fresca were the major contributors to the total daily energy intake per capita. Because caloric sugary beverages are currently the top sources of calories from beverages in the Mexican population, reduction of added sugars from beverages are a major public health concern.

In this context, it is expected that intake of commercial beverages with added sugars will decline in response to the tax. This public health action was important in the context of the obesity epidemic in Mexico. In the future, a careful evaluation of this tax, which was half of what public health researchers and advocates suggested, is needed to learn whether it helped to effectively reduce caloric beverage intake and whether it contributed to improved beverage choices toward more water and other beverages without added sugars in Mexico.

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