Published in final edited form as:

Public Health Nutr. 2018 December ; 21(18): 3296–3306. doi:10.1017/S1368980018002677.

Patterns and Trends in the Intake Distribution of Manufactured and Homemade Sugar-Sweetened Beverages in Pre-Tax Mexico, 1999-2012

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Abstract

Objective: To describe trends across the intake distribution of total, manufactured and homemade sugar-sweetened beverages (SSBs) from 1999 to 2012, focusing on high SSBs consumers and on changes by socioeconomic status subgroups.

Design: We analyzed data from one 24-hour dietary recall from two nationally representative surveys. Quantile regression models at the 50th, 75th and 90th percentiles of energy intake distribution of SSBs were used.

Setting: 1999 Mexican National Nutrition Survey and 2012 Mexican National Health and Nutrition Survey.

Subjects: School-aged children (5–11 years) and women 20–49 years for trend analyses (n=7,718). Population aged >1 years for 2012 (n=10,096).

Results: Over the 1999–2012 period, there were significant increases in the proportion of total and manufactured SSBs consumers (5.7 and 10.7 percentage points), along with an increase in per-consumer SSBs energy intake, resulting in significant increases in per-capita total SSBs energy intake (34, 59 and 95 kcal/d at 50th, 75th and 90th percentiles in school-aged children, and 37, 79 and 109 kcal/d at 50th, 75th and 90th percentiles in women). Total and manufactured SSB intakes increased sharply among low-SES children but remained similar among high-SES children during this time span.

Conclusion: Large increases in SSB consumption were seen between 1999 and 2012 during this pretax SSB period, particularly for the highest consumers. Trends observed in school-aged children are a clear example of the nutrition transition experienced in Mexico. Policies to discourage high intake of manufactured SSBs should continue, joined with strategies to encourage water and low-calorie beverages consumption.

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Authorship: TCA, JMP, BMP designed the research, interpreted results and edited the manuscript. TCA analyzed the data and drafted the manuscript. All authors read and approved the final manuscript.

Conflict of Interest: None.

Keywords

Sugar-sweetened beverages; manufactured sugar-sweetened beverages; homemade sugar-sweetened beverages; intake distribution; high consumers; trend analysis; quantile regression; ENN-99; ENSANUT 2012; Mexico

Introduction

High consumption of sugar-sweetened beverages (SSBs) is an important public health problem in Mexico. SSBs have been recognized as a major driver of long-term weight gain, increased risk of type 2 diabetes and increase in cardiometabolic risk factors[1–5]. The association between SSBs and weight gain is due, at least partly, to the incomplete compensatory reduction in energy intake following consumption of caloric beverages and their high sugar content that affects secretion of hormones, especially insulin[5–9]. Moreover, SSBs may increase risk of type 2 diabetes independently of adiposity due to their high glycemic load that leads to insulin resistance and impaired pancreatic beta cell function[5, 8–10].

Mexico has one of the highest prevalences of excess body weight in the world, with 34.4% of school-aged children, 34.9% of adolescents and 71.3% of adults presenting overweight or obesity[11, 12]. Excess body weight has increased significantly during the last two decades. For school-aged children, overweight and obesity prevalence went from 26.8% to 34.4% in a span of 13 year, increasing an average of 0.6 percentage points per year. Likewise, energy intake from beverages increased significantly from 1999 to 2012[13]. In 2012, SSBs contributed 9.8% to total daily energy intake[14], and were the main source of added sugars[15]. Consequently, reducing intake of SSBs has been the target of several policy measures in Mexico[16]. In 2008, the Mexican Health Ministry summoned an expert panel to develop recommendations on beverage intake for a healthy life[17]. In 2010, sale of sodas and other packaged SSBs were banned from elementary schools[16]. And in 2014, an excise tax of 1 peso per liter (10% price increase approximately) on manufactured non-dairy and non-alcoholic beverages with added sugar and an 8% tax on non-basic energy-dense foods (≥275 kcal/100 g) were implemented[18, 19]. Furthermore, analysis of the impact of the SSBs tax showed a decrease in purchases of taxed SSBs, especially among low-income households[18].

Previous analyses of SSBs intake prior to tax implementation and its trends over time have focused on mean intake[13, 20, 21], however analysis at the mean might miss the potentially widening distribution of intake[22]. This is highly relevant considering that negative health effects of SSBs are expected to be higher among high-consumers[23]. Moreover, increases in SSBs intake observed from 1999 to 2012 could have occurred differently across population subgroups. Mean intake could increase by increasing the proportion of consumers, by increasing amounts consumed, or both. And importantly, significant increases could have occurred among high-consumers. Therefore, the purpose of this study is to describe trends across the intake distribution of total SSBs, manufactured SSBs (potentially taxed) and homemade SSBs (potentially untaxed) from 1999 to 2012, focusing on high SSBs consumers and on changes by socioeconomic status subgroups.

Methods

Design and sample

The 1999 Mexican National Nutrition Survey [ENN-99 (its acronym in Spanish)] and the 2012 Mexican National Health and Nutrition Survey [ENSANUT 2012 (its acronym in Spanish)] are probabilistic population-based surveys with a multistage, stratified sampling design, representative at the national and regional levels and for rural and urban areas. Detailed sampling procedures for both surveys are described elsewhere[24, 25]. Briefly, the ENN-99 was conducted between October 1998 and March 1999. It collected information from 21,503 Mexican households, with a response rate of 82.3%. Due to budget restrictions, it only included preschool and school-aged children (aged 1 to 11 y), and adolescent and adult women in reproductive age (aged 12–49 y)[24]. The ENSANUT 2012 was conducted between October 2011 and May 2012, and collected information from 50,528 households, with a household response rate of 87%[25]. Detailed dietary information was obtained for a subsample in both surveys using a single 24-hour recall.

For trend analyses, we restricted samples from ENN-99 and ENSANUT 2012 to population subgroups included in both surveys: school-aged children (5–11 y) from both sexes, and women between 20 and 49 years with complete dietary and socioeconomic data (n=7,718). Whereas for SSBs intake prior to tax implementation, we used all age-sex subgroups from ENSANUT 2012, which consisted of preschool children 1 year and older who were not being breastfed (1–4 y), school-aged children (5–11 y), adolescent (12–19 y) and adult (≥20 y) males and non-pregnant, non-lactating adolescent and adult females with plausible dietary intake and complete socioeconomic information (n=10,096)[26].

Dietary assessment

The 24-hour recall was collected in person by trained interviewers, and participants were asked to report foods and beverages consumed the previous day at home and away from home, as well as the amount consumed (pieces, household measures, grams or milliliters). In the ENSANUT 2012 an automated 5-step multiple-pass method was used[26], while the methodology for the ENN-99 was a traditional printed questionnaire with similar probes to the multiple pass method. Subjects could report their intake as individual foods or beverages (e.g., chips or soda) or mixed dishes/beverages (e.g. soup or smoothie). Mixed dishes/beverages could be then disaggregated to its ingredients if the participant knew the amounts of each ingredient used in its preparation; or could be recorded as a standard preparation if the participant consumed the dish/beverage away from home or if she/he did not know the recipe. Additionally, participants were asked about foods and beverages consumed between principal meals. Interviewers were trained in techniques to assist participants to avoid omissions and were provided with a food scale, measuring cups and serving spoons to help with the estimation of portion sizes. For children younger than 12 y, the person responsible for food preparation was interviewed, with information completed by the child for food consumed away from home. The 24-hour recall in ENSANUT 2012 was collected between Monday and Sunday, while in ENN-99, it was collected only on weekdays.

Beverage classification

For the present analysis, we defined SSBs as any non-dairy beverage with sugar added either during industrial production or during preparation at home. Commercially prepared and packaged soft drinks, fruit juice beverages, vegetable juice beverages, flavored waters (ready-to-drink and prepared from syrup or powder), iced teas, soy drinks, and sports and energy drinks were classified as manufactured SSBs. "*Aguas frescas*", which are traditional Mexican beverages usually prepared with water, fruit, and sugar; "*atole*" (corn meal beverage) prepared with water and sugar; and homemade coffee or tea with sugar were considered homemade SSBs. Energy content of beverages was estimated based on the milliliters reported and using the 2012 food composition table compiled by the National Institute of Public Health (Nutrient Database, Compilation of the Mexican National Institute of Public Health, unpublished material, 2012) for both surveys to maintain comparability between the two samples. Those who consumed ≥5 kcal/d of manufactured SSBs or homemade SSBs were classified as consumers of manufactured SSBs or consumers of homemade SSBs, respectively. Consumers of SSBs were defined as those who consumed >5 kcal/d of manufactured and/or homemade SSBs.

Sociodemographic information

For both surveys, geographic region was classified as North, Central, or South (States by region: North: Baja California, Baja California Sur, Coahuila, Chihuahua, Durango, Nuevo Leon, Sonora, and Tamaulipas; Central: Aguascalientes, Colima, Estado de Mexico, Guanajuato, Jalisco, Mexico City, Michoacan, Morelos, Nayarit, Queretaro, San Luis Potosi, Sinaloa, and Zacatecas; South: Campeche, Chiapas, Guerrero, Hidalgo, Oaxaca, Puebla, Quintana Roo, Tabasco, Tlaxcala, Veracruz, and Yucatan). Urbanicity was dichotomized into rural and urban areas. Locations with less than 2500 inhabitants were classified as rural and otherwise classified as urban. Socioeconomic status (SES) was assessed using principal components factor analysis based on household characteristics and assets; households were then categorized in tertiles. Educational level of adults was classified into 4 groups: lower than elementary school, finished elementary school, finished middle school, and finished high school or higher (including normal and technical high school).

Statistical analysis

Analyses were conducted in Stata version 14 (StataCorp) and were weighted to be nationally representative and to account for the complex survey design. First, we estimated trends in per-capita and per-consumer SSBs energy intake distribution (kcal/d) from 1999 to 2012 for school-aged children and women (20–49 y) and the three categories of SSBs (total, manufactured, and homemade) using pooled data from both surveys and quantile regression models at the 50^{th}, 75^{th} and 90^{th} percentiles[27, 28]. Models for school-aged children were adjusted by SES, age in years and squared age, sex, geographical region, urbanicity and weekend. Interactions between survey year and SES were included to test whether changes in per-capita intake were significantly different by SES. Models for women were adjusted by SES, age (modeled as restricted cubic splines with 4 knots), educational level, geographical region, urbanicity and weekend, with the same pooling and year interaction terms. To determine the best functional form for age, we fitted a linear regression model for each age

group with the variable modeled as linear, quadratic, restricted cubic spline and categorical. The selection of the most appropriate functional form was based on the model that minimized the Akaike Information Criteria, and for which predicted values fitted the Lowess plot better. To test the significance of differences in changes in SSBs energy intake between 1999 and 2012, we predicted energy intakes using Stata's margins command with the dydx option. Bootstrapped standard errors were calculated with 100 replications to account for the complex survey design, and a p-value of 0.05 with Bonferroni's correction for multiple comparison was used to define statistical significance.

Second, we described per-capita and per-consumer SSBs energy intake distribution from 2012 for the three categories of SSBs. For each category we conducted quantile regression models at the 50^{th}, 75^{th} and 90^{th} percentiles of energy intake. Analyses were stratified by age group, and for adolescents and adults, also by sex. Quantile regression models were adjusted by sex (for preschool and school-aged children), geographical region, urbanicity, SES, educational level (only for adults), and weekend days (Friday through Sunday). Predicted energy intake estimates were obtained from the quantile regression models, and bootstrapped standard errors were calculated with 100 replications to account for the complex survey design.

Informed consent was obtained for participants 18 y and older, and from the parent or guardian of participants younger than 18 y. Assent was obtained for children and adolescents from 5 to 17 y. The survey was approved by the Research, Biosafety, and Ethics Committees at the National Public Health Institute in Cuernavaca, Mexico.

Results

Sociodemographic characteristics of the ENN-99 and ENSANUT 2012 samples are presented in Table 1. The ENN-99 sample and the restricted sample from ENSANUT 2012 include only school-aged children and women 20 to 49 y, thus, proportions by age groups and sex reflect selection criteria. Both surveys had a similar proportion of participants by region and urbanicity. An increase in educational level from 1999 to 2012 (restricted sample) was observed among women 20 to 49 y. Since socioeconomic status was categorized in tertiles for each survey, the proportions are also similar between surveys. The complete sample from ENSANUT 2012 included all age groups and a similar proportion of males and females, with a higher proportion of participants living in urban than in rural areas, and the Central region compared with other geographic regions.

Trends in SSBs intake distribution

From 1999 to 2012, the proportion of consumers of total SSBs increased 5.7 percentage points (pp), from 70.2% to 75.9% (Table 2). While the proportion of homemade SSBs consumers remained similar between years (43.3% in 1999 and 46.3% in 2012), the proportion of consumers of manufactured SSBs increased from 38.6% in 1999 to 49.3% in 2012 – an increase of 10.7 pp. The highest increases in the proportion of consumers of manufactured SSBs were in rural areas, from 26.6 to 41.3%, and in low-SES, from 24.4 to 43.1%, an increase of 14.7 and 18.7 pp, respectively.

Increases in per-capita and per-consumer SSBs energy intake were observed from 1999 to 2012 among school-aged children and women (Table 3). Significant increases in energy intake from total SSBs were estimated at the 50th, 75th and 90th percentile for both age groups, with larger increases towards the high-end of the distributions. Among school-aged children, per-capita energy intake from SSBs increased 34 kcal/d at the median ($p<0.001$), 59 kcal/d at the 75th percentile ($p<0.001$) and 95 kcal/d at the 90th percentile ($p<0.001$). Similar increases were estimated among consumers (34, 55 and 97 kcal/d at 50th, 75th and 90th percentiles, respectively). Among women, estimated per-capita increases were of 37 kcal/d at the median ($p<0.05$), 79 kcal/d at the 75th percentile ($p<0.001$) and 109 kcal/d at the 90th percentile ($p<0.001$); with similar increases among consumers (43, 74 and 150 kcal/d at 50th, 75th and 90th percentiles, respectively). Per-capita and per-consumer increases of manufactured and homemade SSBs were also statistically significant at the 75th and 90th percentiles for school-aged children.

Trends in SSBs intake distribution by SES

Among school-aged children, per-capita increases in total SSBs intake from 1999 to 2012 were statistically significant at the 50th, 75th and 90th percentiles for low- and middle-SES groups, but not among high-SES children (Figure 1). Similarly, for manufactured SSBs, increases were significant for low- and middle-SES, whereas for high-SES, intake at the 75th and 90th percentile remained similar over time. Increases for homemade SSBs were also significant among low-SES children at the 75th and 90th percentile, and among middle-SES children at the 90th percentile. Among low- and middle-SES children, intake increases for manufactured SSBs were higher than for homemade SSBs.

Among women, intake of total SSBs increased significantly for at least one of the estimated percentiles for all SES groups (Figure 2). These increases were higher among middle-SES women, compared to low- and high-SES women. Similarly, increases for manufactured SSBs were higher among middle-SES, compared to low- and high-SES women. Slight increases were observed for homemade SSBs intake, although results did not reach statistical significance, and no important differences were observed between SES groups.

SSBs intake distribution in 2012

Considering all age groups from 2012, an estimated 76.3% of the population consumed either manufactured or homemade SSBs on one given day (Supplemental Table 1). Overall, a higher proportion consumed manufactured SSBs compared to homemade SSBs (51.2% vs 45.0%). Per-capita intake of SSBs was particularly high among adolescents and adults, with energy intakes of 506 kcal/d for adolescent males, 401 kcal/d for adolescent females, 482 kcal/d for adult males and 357 kcal/d for adult females at the 90th percentile (Supplemental Table 2), which correspond to ≈22% of total daily energy intake. Similarly, the highest per-capita intake of manufactured SSBs was observed in adolescent and adult males (90th percentile: 413 and 357 kcal, respectively; representing a contribution of ≈17% of total daily energy intake). Per-capita and per-consumer energy intake of manufactured SSBs was higher than of homemade SSBs at the three explored percentiles and among all age groups (Supplemental Table 3). Per-capita energy intake by type of SSBs and sample characteristics is presented by age groups in Supplemental Tables 4–7.

Discussion

The present analysis of nationally representative dietary intake data builds on previous studies of SSBs intake in the Mexican population by focusing on trends occurring from 1999 to 2012 on the high-end of the intake distribution. Results showed an increase in the proportion of consumers of total and manufactured SSBs, with markedly high increases in subgroups living in rural areas and from low-SES. Likewise, there were statistically significant increases in per-capita and per-consumer SSBs energy intake, with larger increases towards the high-end of the distribution.

For both school-aged children and women, there were significant increases at the 50th, 75th and 90th percentiles in per-capita and per-consumer intake of total SSBs over the 1999 −2012 period. Our findings show that increases in mean intake of SSBs previously estimated[13] were driven both by small increases in the proportion of consumers of 5.7 pp overall for total SSBs, and an increase in the amounts consumed among consumers (34, 55 and 97 kcal/d for school-aged children, and 43, 74 and 150 kcal/d for women at the 50th, 75th and 90th percentiles, respectively), pointing out that increases over time were greater for high-consumers. For manufactured SSBs, there was a considerable increase in the proportion of consumers in the study period (10.7 pp), in addition to increases in per-consumer intakes; reflecting in large increases in per-capita intake at the 75th and 90th percentiles of 44 and 56 kcal/d in school-aged children, and 82 and 83 kcal/d in women, respectively. Our results confirm findings from previous analysis of significant increases in mean per-capita and per-consumer energy intake for "*agua frescas*" and caloric soda over the 1999–2012 period among school-aged children and women[13]. We additionally found that for manufactured SSBs, increases were higher for per-capita intake, while for homemade SSBs, increases were higher for per-consumer energy intake. Meaning that increases for homemade SSBs were mainly among high-consumers, while for manufactured SSBs, increases were in the complete per-capita distribution (by an increased proportion of consumers and amounts consumed).

Moreover, results showed that per-capita intake of total and manufactured SSBs over the 1999 −2012 period increased sharply among low-SES children, while remaining the same among high-SES children. These observed trends in SSBs intake were mirrored with more pronounced increases in overweight and obesity among children from the lowest SES level[12]. The above-mentioned trends observed in school-aged children are a clear example of the nutrition transition experienced in Mexico; where a shift from traditional diets based on legumes, coarse grains and vegetables to processed, high in fat and sugar foods has occurred. This shift tends to affect the high-SES population first, with the low-SES population rapidly catching up[29–34]. However, this trend was not observed in adult women, where increases in the intake distribution of total and manufactured SSBs were observed for all SES subgroups, with higher increases among middle-SES women. These trends were also mirrored by the obesity prevalence in women, with significant increases in the prevalence for the three SES subgroups over the 1999–2012 period, and with the highest prevalence in middle-SES women living in urban areas[35].

In 2012, prior to implementation of the SSB tax, we found very high consumption of SSBs at the 90th percentile (506 kcal/d for adolescent males, 401 kcal/d for adolescent females, 482 kcal/d for adult males and 357 kcal/d for adult females; corresponding to ≈22% of total daily energy intake). In other words, on any given day in 2012, 10% of adolescents and adults consumed at least 22% of their total daily energy intake from SSBs. Still, heavy consumption of SSBs is lower than in the US, where in 2007–2008, 16% in adolescents and 20% in young adults (20–34 y) consumed 500 kcal/d or more from SSBs[36].

A recently published study on individual intakes and household purchases of food and beverages in Mexican population from urban areas concluded that SES was not associated with mean intake of less healthy beverages, which included SSBs, plus sweetened milk and sweetened dairy beverages[38]. Nevertheless, low-SES households had higher purchases of less healthy beverages compared to high-SES households. This discrepancy was hypothesized to be due at least partially by higher intake of homemade SSBs by high-SES individuals[38]. However, in the present analyses, there were no important differences by SES in per-capita energy intake for homemade SSBs at the 50th, 75th or 90th percentiles. The above could be due to loss of precision given the stratifications by age and sex subgroups in the present analysis.

In this context of high SSBs intake, particularly of manufactured SSBs, the effect of the excise tax of one peso per liter on manufactured non-dairy and non-alcoholic SSBs is encouraging, particularly as the greatest reductions in SSBs purchases were found in low-income households[18, 39]. Additionally, low-income households had the greatest increases in water purchases[39]. Considering that substitution of SSBs by water or other low-calorie beverages has been associated with healthier dietary intake, lower energy intake, lower weight gain and lower body fatness[40–43], in an ideal scenario, purchased water is being consumed as plain water. However, this water could also be used to prepare homemade SSBs. Thus, it will be important in the 2018–19 National Health and Nutrition Survey to learn if the amount and proportion of SSBs from homemade SSBs has increased. Analysis of purchases of non-basic taxed foods by Mexican households showed that the proportion of purchases of taxed foods declined more on high-consumers compared to low-consumers[44]. Although this type of analysis has not been conducted for taxed beverages and given the very high intakes of SSBs among high-consumers, it would be informative to estimate a similar effect on SSBs with larger relative declines among high consumers.

There are several limitations in this study. We estimated intake distribution from a single 24-hour dietary recall, which may be insufficient to capture usual intake. Although for the 2012 survey a subsample of ≈10% had a second 24-hour recall that could be used to estimate usual intake, the ENN-99 collected only one day of dietary intake. The intra-individual variance for 2012 could be used to estimate also usual intake for 1999, however, given the important changes in intake in this period, we considered that variance probably changed as well. Moreover, this could be more difficult for episodically consumed foods, however, a significant proportion of the population consumed SSBs on one given day. Therefore, we decided to use a single 24-hour recall for both surveys to ensure comparability. Also, methodological changes in dietary assessment, including the use of printed vs automated 5-step multiple-pass probing and the inclusion of weekend days, may limit the accuracy of the

absolute energy intake changes between surveys; however, the resulting measurement error is likely similar for all subpopulations and food groups, so we focus on differences in trends for different SSB types and by SES subgroups. Still, similar trends were documented using sale data from Euromonitor International[13]. Energy content was estimated using the 2012 food composition table compiled by the National Institute of Public Health for both surveys to maintain comparability. However, reformulation and changes in food manufacturing could have occurred between 1999 and 2012, thus, the energy intake estimation from 1999 might be under- or overestimated if significant changes occurred. As with any data that relies on self-report, estimates may be affected by measurement error. Misreporting could be differential between surveys if the perception of SSBs being unhealthy changed from one survey to the other, since there is evidence that foods perceived as unhealthy tend to be underreported[45]. Despite these limitations, the present study provides valuable information on total SSBs intake distribution and by type of SSBs, and their trends in a nationally representative sample. Moreover, even with a skewed distribution of SSBs intake, quantile regression is an appropriate approach given that is robust to outliers and avoids assumptions about the parametric distribution of the errors. An additional strength is that our study provides baseline description of SSBs consumption in the Mexican population before the implementation of the SSBs tax in 2014.

In summary, this study showed a significant increasing trend at the high-end of the distribution of SSBs intake in the 1999–2012 period, with increases in the proportion of consumers and amounts consumed for total and manufactured SSBs, along with very high consumption of SSBs at the high-end of the distribution of intake prior to the SSBs tax implementation, particularly of manufactured SSBs. Policies to discourage high intake of SSBs should continue in Mexico. At the same time, policies to encourage replacement of manufactured SSBs with water and other low-calorie beverages are needed to avoid replacement by homemade SSBs. Future studies should continue monitoring SSBs intake distribution by type of SSBs to better understand long term changes associated with the tax implementation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

The authors would like to thank Phil Bardsley and Donna Miles for assistance with data management and programming, Denise Ammons for exceptional graphic support, and Frances L. Darcy and Emily Yoon for administrative assistance.

Financial Support: This work was primarily funded by Bloomberg Philanthropies (grants to UNC and Centro de Investigacion en Nutricion y Salud, INSP), with support from the NIH R01DK108148, and the Carolina Population Center and its NIH Center grant (P2C HD050924). Tania Aburto is supported by the Mexican National Council for Science and Technology (CONACyT) scholarship. Funders had no role in the design, analysis or writing of this article.

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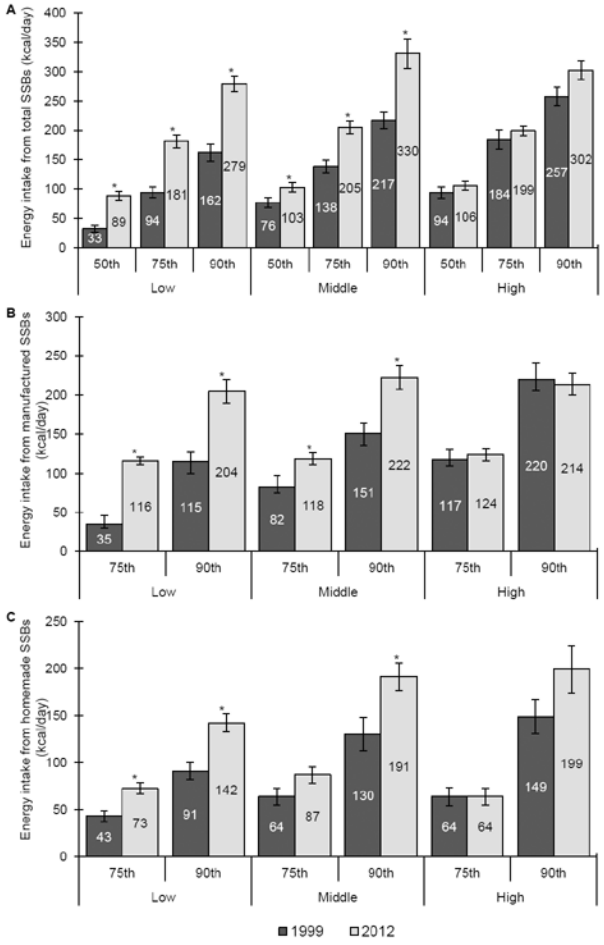

Figure 1.

Estimated per-capita energy intake of total (A), manufactured (B) and homemade (C) SSBs among school-aged children by survey year and socioeconomic status tertile[1,2,3,4]

[1] Data are from the 1999 Mexican National Nutrition Survey (ENN-99) and the 2012 Mexican National Health and Nutrition Survey (ENSANUT 2012).

[2] Total SSBs include manufactured and homemade SSBs. Manufactured SSBs include: soft drinks, manufactured fruit juice beverages, manufactured vegetable juice beverages, flavored waters (ready-to-drink and prepared from syrup or powder), iced teas, soy drinks, and sports and energy drinks. Homemade SSBs include: “Aguas frescas” (beverages prepared with water, fruit, and sugar), “atole” (corn meal beverage), and homemade coffee or tea with sugar.

[3] Values are estimates ± SE from quantile regression at the 50^{th}, 75^{th} and 90^{th} percentile obtained with Stata’s margins command. Standard errors for the quantile regressions were obtained through bootstrapping with 100 replications.

[4] School-aged children 5–11 y, n=4,758. Adjusted by SES, age in years and squared age, sex, geographical region and urbanicity.

* $p<0.05$ for comparison between ENN-99 vs ENSANUT 2012, with Bonferroni’s correction for multiple comparisons.

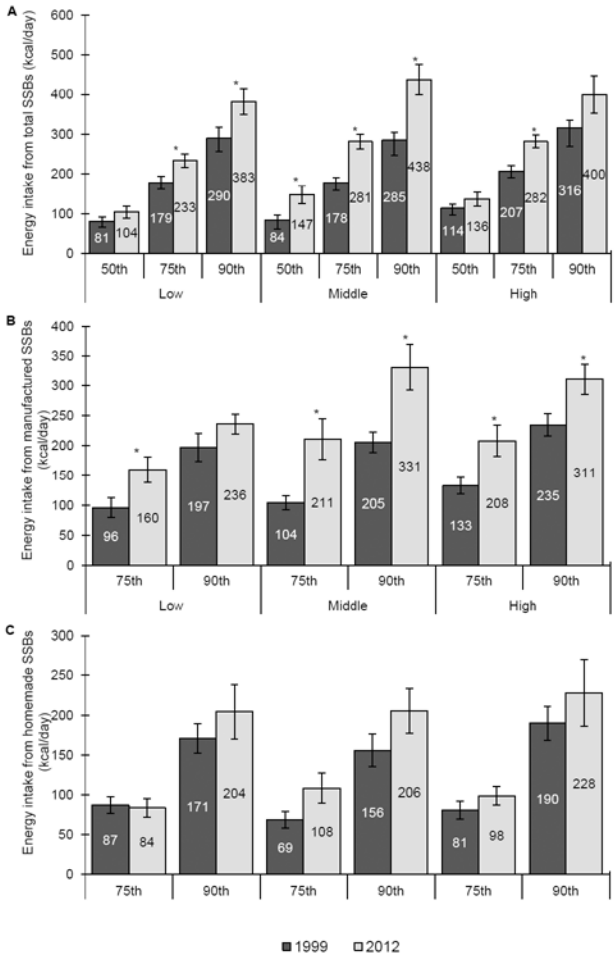

Figure 2.

Estimated per-capita energy intake of total (A), manufactured (B) and homemade (C) SSBs among women 20–49 y by survey year and socioeconomic status tertile[1,2,3]

[1] Data are from the 1999 Mexican National Nutrition Survey (ENN-99) and the 2012 Mexican National Health and Nutrition Survey (ENSANUT 2012).

[2] Total SSBs include manufactured and homemade SSBs. Manufactured SSBs include: soft drinks, manufactured fruit juice beverages, manufactured vegetable juice beverages, flavored waters (ready-to-drink and prepared from syrup or powder), iced teas, soy drinks, and sports and energy drinks. Homemade SSBs include: “Aguas frescas” (beverages prepared with water, fruit, and sugar), “atole” (corn meal beverage), and homemade coffee or tea with sugar.

[3] Values are estimates ± SE from quantile regression at the 50^{th}, 75^{th} and 90^{th} percentile obtained with Stata’s margins command. Standard errors for the quantile regressions were obtained through bootstrapping with 100 replications.

[4] Women 20–49 y, n=2,960. Adjusted by SES, age (modeled with 4 splines), education, geographical region and urbanicity.

* $p<0.05$ for comparison between ENN-99 vs ENSANUT 2012, with Bonferroni’s correction for multiple comparisons.

Table 1

Sociodemographic characteristics of participants by analysis inclusion from ENN-1999 and ENSANUT 2012.

	ENN-99		ENSANUT 2012 - sample used for trend analysis*		ENSANUT 2012 - complete sample	
	n	*%*†	*n*	*%*	*n*	*%*
Total	3,936	100.0	3,782	100.0	10,096	100.0
Age						
1–4 y	-	-	-	-	2,113	7.6
5–11 y	2,005	36.9	2,753	43.5	2,753	16.1
12–19 y	-	-	-	-	2,056	14.5
20–39 y	1,515	49.4	702	37.8	1,188	27.3
40–59 y	416	13.7	327	18.7	969	22.7
>60 y	-	-	-	-	1,017	11.8
Sex						
Male	1,000	18.7	1,405	22.0	4,899	49.5
Female	2,936	81.3	2,377	78.0	5,197	50.5
Geographic region						
North	1,224	19.0	837	18.6	2,402	19.8
Central	1,499	49.1	1,544	47.6	4,186	48.6
South	1,213	31.9	1,401	33.8	3,508	31.6
Urbanicity						
Urban	2,423	73.9	2,352	72.9	6,312	73.0
Rural	1,513	26.1	1,430	27.1	3,784	27.0
Socioeconomic status index						
Lowest tertile	1,412	30.5	1,415	30.4	3,679	30.4
Middle tertile	1,433	34.6	1,315	33.1	3,544	32.1
Highest tertile	1,091	34.9	1,052	36.5	2,873	37.6
Educational Level‡						
Lower than elementary school	168	9.0	51	4.1	493	8.3
Finished elementary school	842	40.3	385	33.2	2,568	43.0
Finished middle school	410	21.4	333	32.3	1,476	28.0
Finished high school or higher	511	29.3	260	30.4	693	20.8

ENN-99, 1999 Mexican National Nutrition Survey; ENSANUT 2012, 2012 Mexican National Health and Nutrition Survey.

*ENSANUT 2012 – sample used for trend analysis' presents characteristics for school-aged children (5–11 y) and women from 20 to 49 y.

†Values are unweighted sample size and weighted percentages.

‡Educational level is only from adults (>20 y).

Table 2.

Proportion of consumers of sugar-sweetened beverages (SSBs) by type of SSBs, survey year, and sociodemographic characteristics.

	ENN-99						ENSANUT 2012 – Sample used for trend analysis*					
	Consumers of Total SSBs†		Consumers of Manufactured SSBs		Consumers of Homemade SSBs		Consumers of Total SSBs		Consumers of Manufactured SSBs		Consumers of Homemade SSBs	
	% ‡	*SE*	%	*SE*	%	*SE*	%	*SE*	%	*SE*	%	*SE*
Total	70.2	1.1	38.6	1.3	43.3	1.2	75.9 //	1.2	49.3 //	1.4	46.3	1.5
Age												
5–11 y	66.6	1.9	36.2	1.8	39.8	1.9	72.0	1.6	48.0 //	1.4	39.3	1.4
20–39 y	71.9	1.6	41.1	1.7	43.6	1.7	80.9 //	2.0	53.2 //	2.8	53.4 //	2.6
40–59 y	73.9	2.8	35.6	3.1	51.6	3.2	74.7	3.7	44.8	3.9	48.4	4.2
Sex												
Male	66.5	2.5	37.7	2.6	38.1	2.4	72.2	2.2	48.1 //	2.1	37.2	1.9
Female	71.0	1.2	38.7	1.3	44.5	1.3	76.9 //	1.4	49.7 //	1.7	48.9	1.8
Geographical region												
North	76.2	1.8	57.4	2.2	30.3	2.0	80.6	2.0	63.5	2.7	36.7	2.7
Central	66.5	1.8	38.0	2.0	40.0	1.7	74.6 //	2.0	51.9 //	2.4	43.9	2.4
South	72.4	1.9	28.1	1.8	56.2	2.1	75.0	2.0	38.0 //	2.0	55.0	2.2
Urbanicity												
Urban	71.6	1.4	42.8	1.5	41.5	1.4	75.8	1.5	52.3 //	1.8	43.9	1.8
Rural	66.3	2.0	26.6	1.9	48.6	2.3	76.0 //	1.8	41.3 //	2.0	53.0	2.4
Socioeconomic status index												
Lowest tertile	66.2	2.2	24.4	1.8	50.4	2.3	76.2 //	2.0	43.1 //	2.2	51.0	2.4
Middle tertile	68.0	2.0	42.5	2.0	39.0	2.0	78.7 //	1.8	50.8 //	2.4	47.4 //	2.6
Highest tertile	75.9	1.8	47.0	2.2	41.4	2.1	73.0	2.3	53.2	2.7	41.5	2.6
Educational Level§												
Lower than elementary school	68.6	4.7	25.8	4.7	50.5	5.2	77.1	7.8	31.2	8.8	53.6	9.2

	ENN-99						ENSANUT 2012 – Sample used for trend analysis*					
	Consumers of Total SSBs†		Consumers of Manufactured SSBs		Consumers of Homemade SSBs		Consumers of Total SSBs		Consumers of Manufactured SSBs		Consumers of Homemade SSBs	
	% ‡	*SE*	%	*SE*	%	*SE*	%	*SE*	%	*SE*	%	*SE*
Finished elementary school	72.0	2.1	38.2	2.3	45.7	2.4	81.6 //	2.5	48.5	4.2	53.8	3.9
Finished middle school	73.4	3.2	44.0	3.4	46.8	3.4	78.6	3.2	52.2	3.9	51.6	3.8
Finished high school or higher	73.0	2.6	43.7	2.8	42.3	2.8	76.4	3.9	53.0	4.4	49.5	4.2

ENN-99, 1999 Mexican National Nutrition Survey; ENSANUT 2012, 2012 Mexican National Health and Nutrition Survey; Prop, proportion; SE, standard error.

*ENSANUT 2012 – sample used for trend analysis' presents characteristics for school-aged children (5–11 y) and women from 20 to 49 y.

†Consumers of total SSBs includes consumers of either manufactured or homemade SSBs. Manufactured SSBs include: soft drinks, packaged fruit juice beverages, packaged vegetable juice beverages, flavored waters (ready-to-drink and prepared from syrup or powder), iced teas, soy drinks, and sports and energy drinks. Homemade SSBs include: "Aguas frescas" (beverages prepared with water, fruit, and sugar), "atole" (corn meal beverage), and homemade coffee or tea with sugar.

‡Values are weighted percentages.

§Educational level is only from adults (>20 y).

//$p<0.05$ for comparison between ENN-99 vs ENSANUT 2012 consumers, with Bonferroni's correction for multiple comparisons.

Table 3.

Trends in estimated per-capita and per-consumer energy intake (kcal/d) at the 50th, 75th and 90th percentiles from total, manufactured and homemade sugar-sweetened beverages (SSBs) for school-aged children and women from ENN-99 and ENSANUT 2012.*

	50th percentile					75th percentile					90th percentile				
	1999		2012		*p-value*	1999		2012		*p-value*	1999		2012		*p-value*
	Est. †	SE	Est.	SE		Est.	SE	Est.	SE		Est.	SE	Est.	SE	
School-aged children ‡															
Per-capita *(n=4,758)*															
Total energy	1380	24	1660	28	***<0.001***			2190	42	***<0.001***	2170	37	2880	77	***<0.001***
Total SSBs	65	4	99	5	***<0.001***	135	7	194	6	***<0.001***	208	7	303	12	***<0.001***
Manufactured SSBs	16	4	16	3	***>0.99***	75	8	119	4	***<0.001***	157	9	213	9	***<0.001***
Homemade SSBs	7	2	7	2	*>0.99*	56	6	75	5	***<0.05***	121	8	175	10	***<0.001***
Per-consumer															
Total SSBs *(n=3,437)*	106	5	140	4	***<0.001***	176	6	231	7	***<0.001***	246	11	343	13	***<0.001***
Manufactured SSBs *(n=2,213)*	111	7	121	3	*0.2*	174	8	199	6	***<0.05***	239	10	289	10	***<0.001***
Homemade SSBs *(n=1,872)*	70	4	103	5	***<0.001***	122	9	179	9	***<0.001***	187	12	281	16	***<0.001***
Women §															
Per-capita *(n=2,960)*															
Total energy	1380	25	1660	51	***<0.001***	1780	23	2220	60	***<0.001***	2280	49	2810	96	***<0.001***
Total SSBs	95	6	132	12	***<0.05***	190	8	269	11	***<0.001***	299	12	408	25	***<0.001***
Manufactured SSBs	17	5	25	10	***0.4***	114	8	196	16	***<0.001***	215	13	298	16	***<0.001***
Homemade SSBs	10	3	10	6	*0.9*	78	6	98	8	***<0.05***	174	12	215	21	*0.08*
Per-consumer															
Total SSBs *(n=2,194)*	149	5	192	13	***<0.05***	232	8	306	13	***<0.001***	326	12	476	29	***<0.001***
Manufactured SSBs *(n=1,281)*	151	7	194	17	***<0.05***	229	10	275	14	***<0.05***	328	20	388	35	*0.07*
Homemade SSBs *(n=1,398)*	89	4	96	7	*0.4*	161	10	165	15	*0.8*	256	18	326	24	***<0.05***

ENSANUT 2012, 2012 Mexican National Health and Nutrition Survey; ENN-99, 1999 Mexican National Nutrition Survey; Est, estimates; SE, standard error.

[*] Total SSBs include manufactured and homemade SSBs. Manufactured SSBs include: soft drinks, packaged fruit juice beverages, packaged vegetable juice beverages, flavored waters (ready-to-drink and prepared from syrup or powder), iced teas, soy drinks, and sports and energy drinks. Homemade SSBs include: “Aguas frescas” (beverages prepared with water, fruit, and sugar), “atole” (corn meal beverage), and homemade coffee or tea with sugar.

[†] Values are estimates from quantile regression at the 50^{th}, 75^{th} and 90^{th} percentile obtained with Stata’s margins command. Standard errors for the quantile regressions were obtained through bootstrapping with 100 replications.

[‡] School-aged children 5–11 y, n=4,758. Adjusted by SES, age in years and squared age, sex, geographical region and urbanicity.

[§] Women 20–49 y, n=2,960. Adjusted by SES, age (modeled with 4 splines), education, geographical region and urbanicity.