Socio-demographic and economic factors associated with the consumption of sugar-sweetened beverages in Mexico

Víctor Manuel Gerónimo Antonio [a] and Nazaret Flores Espínola[a]

[a] Universidad Autónoma Agraria Antonio Narro, Mexico.

Email addresses: vm.geronimo85@gmail.com and nazaflorese31@gmail.com, respectively.

Date received:September 28, 2024. Date of acceptance: February 4, 2025.

Abstract

This research aims to identify the socio-demographic and economic factors influencing the probability of sugar-sweetened beverage consumption (SSBC) in Mexican households between 1992 and 2022. Logit econometric models and data from the National Household Income and Expenditure Survey (ENIGH, for its acronym in Spanish) are used. The results show that the likelihood of SSBC increases with the number of employed workers and the income quintile if the household is urban, the head of the household is male, and there are minors. Meanwhile, increasing the age and level of education of the head of the household, as well as the presence of adults over 65 years of age, decreases the probability of SSBC.

Keywords: consumption; household; sugar-sweetened beverages; sociodemographic factors; Logit model.

1. INTRODUCTION

There is widespread interest in analyzing sugar-sweetened beverage consumption (SSBC). This is mainly because high SSBC has been linked to health risk factors such as obesity, diabetes, cardiovascular disease and certain types of cancer (Malik & Hu, 2022; Li *et al.*, 2023). Thus, excessive SSBC is considered a public health problem because they contain a substantial amount of added sugar, artificial food colorings and preservatives that negatively affect people's health (Farsad-Naeimi *et al.*, 2020).

The amount of sugar-sweetened beverages consumed by some population groups has shown an upward trend and already exceeds the daily limits recommended by the World Health Organization (World Health Organization [WHO], 2015). In this regard, Lara-Castor *et al.* (2023) analyzed the intake of sugar-sweetened beverages among adults in 185 countries and found that SSBC increased by 16% between 1990 and 2018, although it slowed down between 2005 and 2018. However, SSBC levels vary depending on the region of the world; for example, in 2018, the highest consumers were in South Asia, sub-Saharan Africa and Latin America and the Caribbean. At the country level, the highest average SSBC was recorded in Mexico followed by Ethiopia, the United States and Nigeria. Previously, in 2015, the Pan American Health Organization (PAHO) indicated that Mexico was the world's number one consumer of sugar-sweetened beverages with an average consumption of 163 liters of sugar-sweetened beverages per person per year in 2011.

Due to the high levels of SSBC in Mexico, the country ranks first for mortality and morbidity attributable to the consumption of these sugar-sweetened beverages (Braverman-Bronstein *et al.*, 2020). To counteract this situation, the country has implemented public policies in the following order: in 2009, regulations regarding the advertising of sugar-sweetened beverages were established, although there is limited information on the impact of these measures (Bergallo *et al.*, 2018). In 2014, a special tax on beverages with added sugars was introduced, which led to an 8.2% decrease in the purchase of these beverages two years later, with households located in urban areas and those with low socioeconomic levels registering the largest decrease (Colchero *et al.*, 2017). More recently, in 2020, warning labels for certain nutrients, including added sugars, were added to the front of packaging (Ministry of Economy [SE], 2020).

To gain a broader understanding of the high consumption of sugar-sweetened beverages, an analysis of the factors associated with SSBC is needed; in particular, a study of how the social and economic context in which a person is raised influences their decisions regarding what they consume and drink (Purohit *et al.*, 2023). Similarly, Gozali *et al.* (2023) point out that the head of the family is the one who makes most of the decisions in relation to the household, including SSBC, which means that the socioeconomic and demographic characteristics of the head of the family influence consumption in the household. In this regard, previous studies have shown that SSBC is associated with people's gender, age, educational level, socioeconomic level and occupation, as well as the urban or rural area in which they live (Schneider *et al.*, 2020; Al-Hanawi *et al.*, 2022; Santana-Jiménez *et al.*, 2023). However, there are few studies that analyze the determinants of SSBC in the case of Mexico. For this reason, this paper seeks to answer the following research questions: Have there been changes in SSBC in Mexican households between 1992 and 2022? How are economic level and socio-demographic characteristics of households associated with SSBC? Specifically, this paper aims to identify the sociodemographic and economic factors that influence the likelihood of SSBC in Mexican households between 1992 and 2022.

The empirical analysis of this research was carried out in two stages: the first was based on a comparative descriptive analysis of SSBC between two points in time. The second was an econometric analysis consisting of the estimation of Logit regression models to identify how sociodemographic and economic characteristics affect the probability of SSBC. Data from the National Household Income and Expenditure Survey (ENIGH) for the years 1992 and 2022 was used.

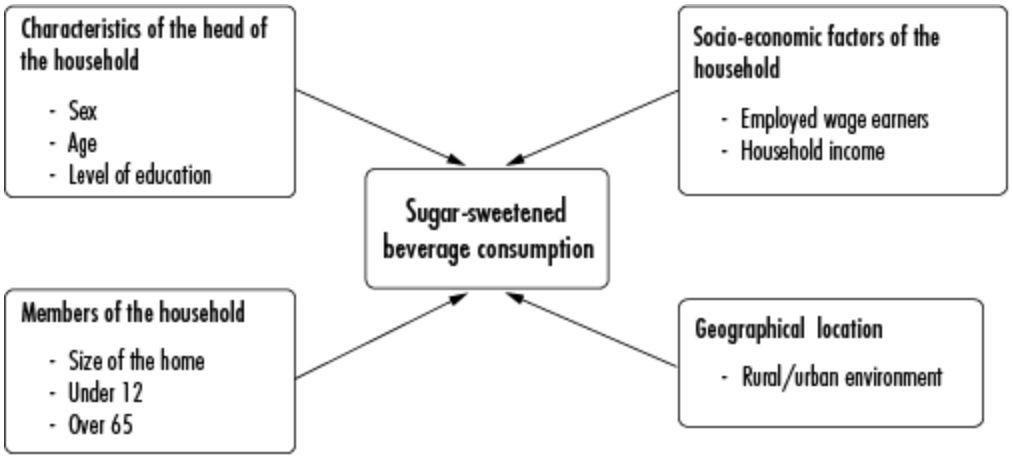
The study is structured as follows: in the first section, after the introduction, the conceptual model describing the socio-demographic and economic factors associated with SSBC is presented. The data and methodology used are then described, followed by the results and discussion. Finally, the conclusions are presented.

2. SOCIO-DEMOGRAPHIC AND ECONOMIC FACTORS ASSOCIATED WITH SSBC

Excessive SSBC is a multifactorial phenomenon with diverse implications on health and family finances (Sosa and Mancera, 2022). Therefore, there is a need to analyze it based on different disciplines, not only to understand the social complexity of the problem, but also to design public policies that lead to a reduction in the consumption of sugar-sweetened beverages. In order to contribute to the knowledge on the subject from an economic point of view, the objective is to identify the socio-demographic and economic factors that influence the likelihood of SSBC in Mexican households. As shown in Figure 1, there is a representation of the conceptual model of the variables divided into four categories: the first refers to the characteristics of the head of the household in terms of age, sex and educational level; the second refers to the members of the household in terms of the number of people in said household, the presence of children and elderly adults; the third considers economic factors, represented by

household income and the number of people who receive monetary income and have a job; finally, the rural and urban environment of the household is included.

Figure 1. Conceptual model of the determinants of SSBC



Source: prepared by the authors based on a review of specialized literature.

According to the National Institute of Statistics and Geography (INEGI, 2023): "the head of the household is the person recognized as such by the other members of the household". The most relevant factors associated with the awarding of this recognition are related to aspects of hierarchy, either because they contribute the majority of the income, are the oldest person or are the one who makes the most important decisions in the household (Muñiz and Hernández, 1999). In this regard, it is assumed that the head of the household plays an important role in the types and quantities of drinks consumed, and therefore three of their characteristics were considered.

Characteristics of the head of the household

With respect to the sex of the head of the household, the likelihood of SSBC is expected to be higher when the head of the household is a male than when the head of the household is a female. This idea has been proposed by Al-Hanawi *et al.* (2022), who point out that men are more likely to consume higher amounts of sugar-sweetened beverages than women. This could be because men tend to be less concerned about the products they consume, while women are more concerned about adopting healthy eating habits that allow them to take care of their physical appearance and, where appropriate, instill these healthy practices in their children (Lozano *et al.*, 2021).

Regarding the age of the head of the household, the effect on the likelihood of SSBC tends to decrease as they get older. In this respect, Raiteri (2015, p. 16) mentions that "a person's stage in life will influence the products and services they choose to meet their needs." Therefore, it is assumed that people tend to be more concerned about their health as they get older, so the older the head of the family, the less likely they are to buy unhealthy products such as beverages with high sugar content.

In relation to educational level, the probability of SSBC in the home is expected to decrease as the educational level of the head of the household increases. This has been empirically demonstrated by those who found that SSBC was significantly higher among people with low levels of education than among those with high educational levels.

Therefore, it is assumed that consumers with higher levels of education tend to be more aware of and responsible for the consequences generated by the products they consume; i.e., they have greater access to information about the negative health impacts of sugar-sweetened beverage consumption (Raiteri, 2015).

Characteristics of household members

The characteristics of household members also influence beverage consumption. First, it is assumed that SSBC increases as the number of household members increases. This assumption is based on two factors: first, the theory of demand establishes that for each additional member joining a family, a greater quantity of goods is required to satisfy household consumption needs (Varian, 2022). Furthermore, over time, there has been an increase in the supply and diversity of sugar-sweetened beverages at more affordable prices in the market, which may lead to a real increase in income per household member, i.e., it is possible that the effects of income may lead to a higher probability of purchasing and consuming these types of beverages.

Secondly, the presence of members under the age of 12 in the household is expected to have a positive influence on the probability of SSBC. According to Tojo (2003), during childhood and adolescence, water requirements are relatively higher than in adults due to their different body composition; however, they do not choose plain water to quench their thirst and maintain good hydration. On the contrary, Muth *et al.* (2019) point out that children and adolescents have shown a notable increase in the consumption of sports drinks, fruit-flavored soft drinks, and sodas in recent decades, adding that nearly half of the calories they consume come exclusively from these types of beverages.

Thirdly, the presence of family members over 65 years of age in the household is expected to negatively affect the probability of SSBC. This premise is based on the statement made in 2021 by the Food and Agriculture Organization of the United Nations (FAO, 2021) that the elderly are more vulnerable to disease, which leads them to take care of themselves and be concerned about their health. As a result, they tend to consume healthy foods and beverages that contribute to their well-being. Therefore, when the household includes at least one elderly member, a reduction in sugar-sweetened beverage consumption is expected.

Household economic factors

Income and the number of employed earners were considered among the economic factors related to the household, With regard to an increase in household income, the probability of SSBC is expected to increase. This approach is based on consumer theory, which establishes a positive relationship between income and consumption (Varian, 2022); therefore, an increase in household budget tends to increase the demand for sugar-sweetened beverages. This relationship has been confirmed in empirical studies, which have found that an increase in income leads to higher consumption of beverages such as soft drinks (Barquera *et al.*, 2008).

In terms of the number of people earning a paid income, there is a positive relationship with the likelihood of SSBC. In other words, when there are more income earners, the household budget improves, resulting in an increase in SSBC for two reasons: the first is due to an improvement in purchasing power; the second is due to the fact that a larger number of income earners is likely to increase the time spent on paid activities outside the home, which changes consumption tastes and needs, increasing the propensity to consume sugar-sweetened beverages.

Geographical location: rural and urban areas surrounding the home

The rural or urban context in which household members live influences their consumption preferences. In this respect, urban households tend to show a higher probability of SSBC than rural households. Several elements modify taste and preference for sugar-sweetened beverages depending on the geographical environment, including rapid urbanization, which creates conditions for a greater number of supermarket chains offering a wide variety of sugar-sweetened beverages (FAO, 2018). Likewise, beverage companies have improved the logistics of sugar-sweetened beverage distribution in rural areas, which results in families living in rural areas changing their consumption habits and patterns, particularly with regard to the gradual increase in the consumption of soft drinks and other sugar-sweetened beverages (Popkin and Reardon, 2018).

3. METHODOLOGY

Data

Microdata from the ENIGH for 1992 and 2022 (INEGI) was used, and the household was taken as the unit of study. The years selected were based on the availability of databases that are comparable and statistically representative of the entire Mexican territory. These databases are cross-sectional as the same households are not surveyed in the two years analyzed.

Two data tables were used to construct the variables: household concentration and household expenditure. The first table provided total current household income and the sociodemographic and occupational characteristics of household members. The second table provided the expenditure code, which allowed for the selection of six groups of sugar-sweetened beverages consumed by households: *1)* cola and flavored soft drinks; *2)* natural syrup, lechugilla, sangrita, and tascalate; *3)* mineral water, quinine water and demineralized water with or without flavor; *4)* packaged juices and nectars; *5)* prepared water and natural juices; *6)* energy drinks. Subsequently, for each beverage group, the average weekly consumption (liters) per household and per income quintile was calculated.

Analysis techniques

The empirical analysis was carried out in two stages: descriptive analysis and econometric analysis. The first stage was devoted to answering the first research question: Were there changes in SSBC consumption in Mexican households between 1992 and 2022? This consisted of the carrying out of a comparative analysis (between the two years studied) of the average weekly consumption of each group of sugar-sweetened beverages per household and by income quintiles. It should be noted that the 1992 ENIGH did not yet record the consumption of prepared water and natural juices, nor energy drinks, so it was not possible to compare the intake of these beverages for the period analyzed. Similarly, a comparison was carried out of the sociodemographic and economic characteristics associated with the household. For the statistical analysis, the Statistical Package for the Social Sciences (SPSS) software was used, and the expansion factor was used to make population inferences from the sample.

The second stage of the analysis addressed the second question: How are the economic level and sociodemographic characteristics of households associated with SSBC in Mexico? To this end, binary logit econometric models were estimated, and the empirical model proposed in the work of Llamas *et al.* (2012) was

considered, which analyzes the probability of food and beverage consumption outside the home for Mexico. Logistic regression models have been useful for analyzing the determinants of SSBC in various countries, such as the United States (Tasevska *et al.*, 2017), South Africa (Pengpid and Peltzer, 2019), Indonesia (Gozali *et al.*, 2023) and Saudi Arabia (Alfaris *et al.*, 2022).

According to Greene (2012), in the binary Logit model, the dependent variable Y_i considers two events, coded with a value of 1 if the household consumed sugar-sweetened beverages and 0 if it did not; while the set of independent variables is referred to as X_i. According to Wooldridge (2010, p. 584), the specification of this model allows the probability of SSBC in a household to be expressed as follows:

$$P(Y_i = 1|\, X_i) = G(\beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k) = G(\beta_0 + X\beta) = G(X_i \beta_i) \quad (1)$$

Where: G is a logistic function that assumes values strictly between 0 and 1 for all real numbers z, which can be expressed as:

$$G(z) = \exp(z)/[1 + exp(z)] = \Lambda(z) \quad (2)$$

Continuing with Wooldridge (2010), the G function is increasing and increases more rapidly at $z = 0$, $G(z) \rightarrow 0$ as $z \rightarrow -\infty$ and $G(z) \rightarrow 1$ as $z \rightarrow \infty$. Meanwhile, the vector β_i represents the effect of the independent variables, X_i, on the probability of the event. This functional relationship is represented as:

$$Y_i = F(X_i, \beta_i) + \mu_i \quad (3)$$

The disturbance μ_i has a standard logistic distribution and is independent of X_i. Based on the established assumptions, the following empirical model was proposed:

$$\begin{aligned} \text{SSBC} = {} & \beta_0 + \beta_1(\text{sex}_{\text{head}}) + \beta_2(\text{age}_{\text{head}}) + \beta_3(\text{ed}_{\text{head}}) + \beta_4(\text{size}_{\text{household}}) \\ & + \beta_5(\text{under}_{12\text{a}}) + \beta_6(\text{over}_{65\text{a}}) + \beta_7(\text{earner}) + \beta_8(\text{quintile}) \\ & + \beta_9(\text{urban}) + \mu_i \end{aligned} \quad (4)$$

Where:

- SSBC = binary variable denoting whether the household consumed sugar-sweetened beverages (yes = 1, no = 0).
- Head_sex = sex of the head of the household (male = 1, female = 0).
- Head_age = age in years of the head of the household.
- Head_ed = dichotomous variable indicating whether the head of the household has a bachelor's or postgraduate degree (yes = 1, no = 0).
- Household_size = number of members in the household.
- Under_12 = binary variable indicating whether there are children under 12 years of age in the household (yes = 1, no = 0).

- Over_65 = binary variable indicating whether there are individuals aged 65 or over in the household (yes = 1, no = 0).
- Earner = number of employed income earners in the household.
- Quintile = quintile to which the household belongs according to its total current monthly income (base: first quintile).
- Urban = location of the household (urban = 1, when it has 15,000 or more inhabitants; rural = 0, when it has less than 15,000 inhabitants).
- β_0, β_1 ..., β_9 = regression coefficients of the Logit model.
- μ_i = random error term.

With the support of STATA econometric software, Logit models were estimated using the Maximum Likelihood method, and robust standard errors were considered to mitigate the problem of heteroscedasticity (Malhotra, 1984). The interest of this study is to determine the marginal effect of sociodemographic and economic variables on the probability of SSBC; therefore, the slopes were calculated using the regression coefficients derived from the estimated models.

4. RESULTS AND DISCUSSION

Descriptive analysis

Below are some sociodemographic and economic characteristics of households in Mexico (see Table 1). Regarding variables associated with the head of the household, it was found that 14.20% of households had a female head in 1992; 30 years later, this figure had doubled to 32.40%. Likewise, the average age of the head of the household was 10 years older in 2022 than in 1992. A percentage increase was identified in the number of heads of households with university education, given that 18.50% of them had a bachelor's or postgraduate degree in the second year analyzed.

Table 1. Socio-demographic and economic characteristics of households in Mexico, 1992 and 2022

Characteristic	*1992*	*2022*
Sample	10 530	90 102
Total households (expanded sample)	18 536 267	37 560 123
Proportion of households headed by women	14.20	32.40
Average age of the household head	41.37	51.39
Proportion of households headed by someone with a bachelor's or postgraduate degree	10.60	18.50
Average number of household members	4.69	3.43
Proportion of households with children under 12	64.60	39.10
Proportion of households with people aged 65 or over	16.40	25.70
Average number of employed income earners	1.50	1.62
Current average monthly income (2022 Mexican pesos)	17 221.43	21 231.82
Proportion of urban households*	63.40	77.70

Note: *A household was considered urban if it was located in a town with 15,000 or more inhabitants and rural if it was located in a town with fewer than 15,000 inhabitants.

Source: Prepared by the authors using data from the ENIGH (1992 and 2022).

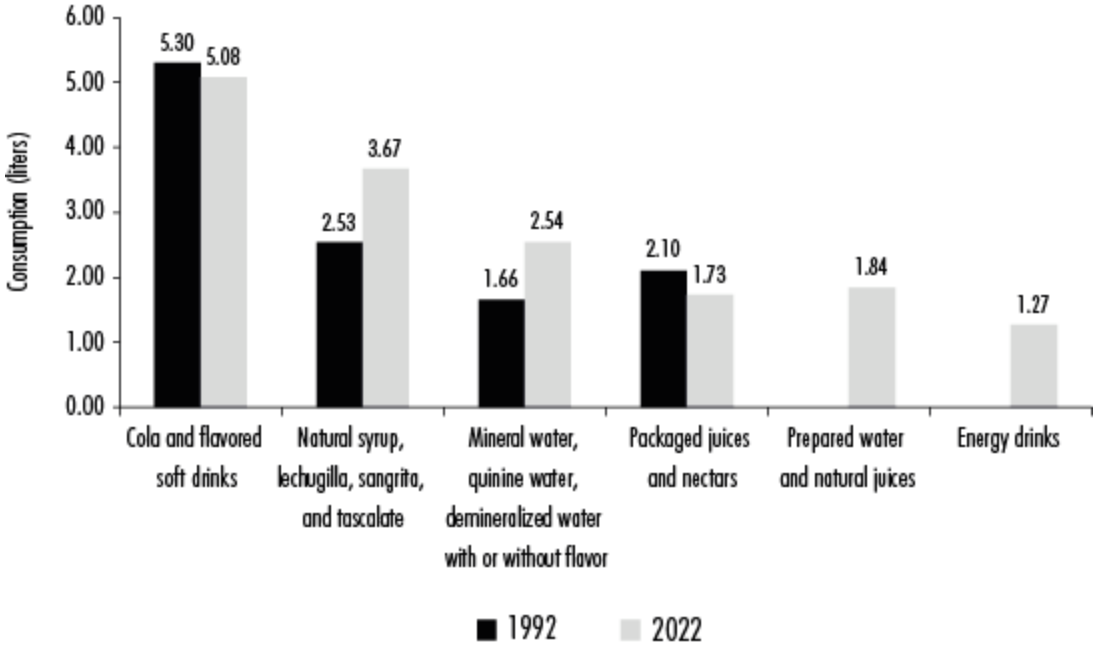
As far as household characteristics are concerned, there has been a reduction in the average number of people per household, from 4.69 in 1992 to 3.43 in 2022. Similarly, there has been an increase in the proportion (9.30% in 1992) of households with members aged 65 or over, with a quarter of households having at least one elderly adult among their members in 2022. Conversely, the presence of children under 12 years of age in the home has decreased by 25.50%: in 1992, 64.60% of households had one or more children, whereas this percentage had decreased to 39.10% in 2022.

With regard to household-related economic variables, it can be noted that the employment dynamics and monetary resources of household members have changed over the last three decades. This can be observed in the average number of people receiving income as compensation for their work, which increased from 1.50 in 1992 to 1.62 in 2022, suggesting that in addition to the head of the household, other members also contribute income to the household. Likewise, there has been an increase in household purchasing power as the average real monthly income per household increased by 23.28% between 1992 and 2022. Finally, it was found that 63.40% of households were located in urban areas in 1992, with this percentage rising to 77.70% in 2022, suggesting that the urban environment plays an important role in the dynamics of people's lives.

The average weekly consumption per household and type of sugar-sweetened beverage for 1992 and 2022 is shown below (see Figure 2). In both years, cola and flavored soft drinks were the most consumed beverages, although consumption fell slightly by 4.15% over three decades; however, average consumption per household has remained above 5 liters per week. Similarly, there has been a 17.62% drop in the average consumption of packaged juices and

nectars since in 1992 households consumed an average of 2.54 liters per week, while in 2022 consumption stood at 1.73 liters.

Figure 2. Average weekly consumption (liters) of sugar-sweetened beverages per household, 1992 and 2022

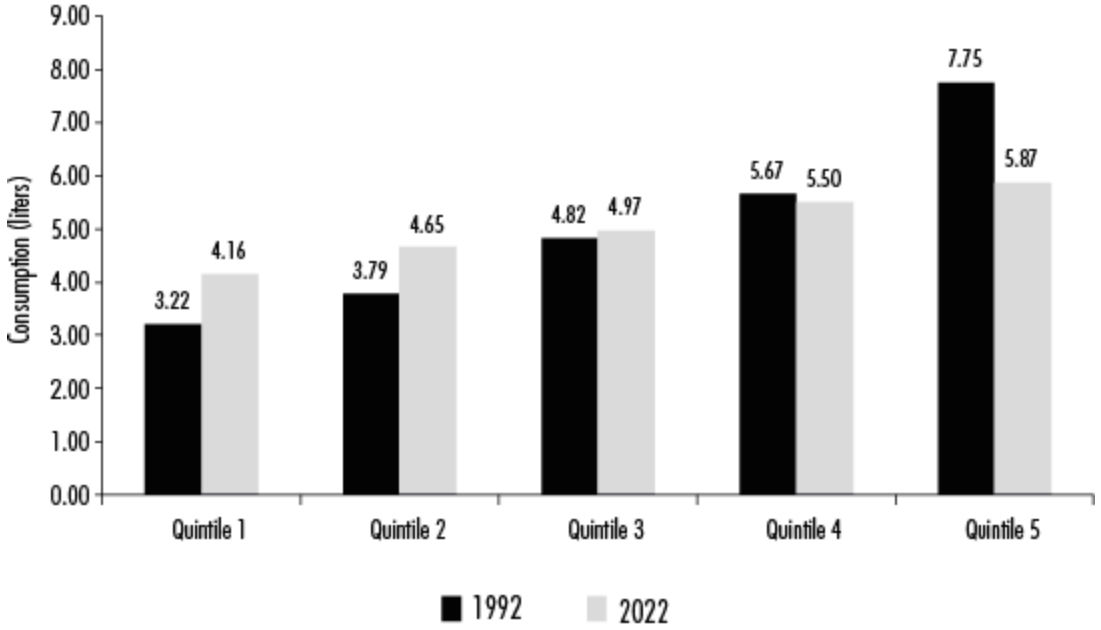


Source: prepared by the authors with data from the ENIGH (1992 and 2022).

Similarly, two beverage groups recorded the highest increases in terms of average household consumption between the two years analyzed: 53.01% for mineral water, quinine, demineralized with or without flavor, and 45.05% for natural syrup, lechuguilla, sangrita, and tascalate. The analysis also suggests that households have diversified their beverage consumption patterns, for example, there has been an increase in the consumption of prepared water and natural juices, as well as energy drinks with household consumption exceeding one liter per week in 2022.

In order to show whether there is a differentiated behavior in the consumption of sugar-sweetened beverages according to household income quintile, Figure 3 shows the average weekly consumption of cola and flavored soft drinks, while Figure 4 illustrates the consumption of packaged juices and nectars. These beverages were chosen for two reasons: first, families spend more money on these beverages; of the total expenditure allocated to the purchase of sugar-sweetened beverages, 86.54% was spent on soft drinks and 8.55% on juices (ENIGH, 2022); second, this group of beverages contains a high concentration of total sugars, including fructose, glucose, sucrose, corn syrup or mixtures thereof (Federal Consumer Protection Agency [PROFECO], 2023).

Figure 3. Average weekly consumption (liters) of cola
and flavored soft drinks, by household quintiles, 1992 and 2022

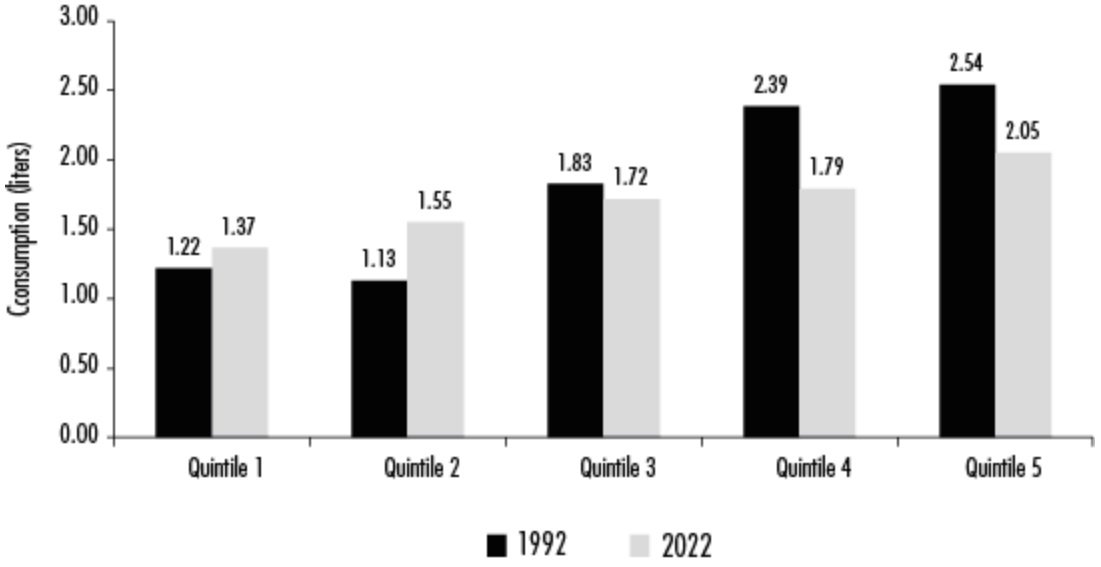


Source: prepared by the authors using data from the ENIGH (1992 and 2022).

As shown in Figure 3, for both years, the higher the income quintile of the household, the higher the consumption of soft drinks. For example, quintile 5 consumed twice as much as quintiles 1 and 2 in 1992, and quintile 5 also had the highest average consumption, at 7.75 liters per week. However, it can be seen that households with higher purchasing power reduced their soft drink consumption between 1992 and 2022, with quintile 5 reducing their consumption the most. In contrast, lower-income households (quintiles 1 and 2) increased their soft drink consumption by approximately one liter per week. Middle-income households (quintiles 3 and 4) maintained their soft drink consumption virtually unchanged, with a trend close to 5 liters per week.

The average consumption of packaged juices and nectars increases progressively according to household income quintile; however, juice consumption is significantly lower, ranging from 2.5 to 3 times less than the amount of soft drinks consumed (see Figure 4). Likewise, quintiles 3, 4, and 5 showed a decrease in the average consumption of these beverages in 2022 compared to 1992; specifically, quintile 5 decreased its consumption from 2.54 to 2.05 liters on average per week. In contrast, quintiles 1 and 2 increased their consumption of these beverages, with quintile 2 recording the highest growth (37.17%) in consumption between the first and second years analyzed.

Figure 4. Average weekly consumption (liters) of packaged juices and nectars, by household quintiles, 1992 and 2022



Source: prepared by the authors using data from the ENIGH (1992 and 2022).

Econometric analysis

The regression coefficients are presented in Table 2 and are derived from the Logit models that showed the best relative fit quality as indicated by the Akaike and Schwarz criteria (Malhotra, 1984). Likewise, the models show total significance at a confidence level of 99%, according to the Chi-square statistic (χ^2). In addition, the percentage of correctly predicted cases is acceptable and there are no multicollinearity problems in the selected models, according to the Belsley-Kuh and Welsch tests and the Variance Inflation Factor (Greene, 2012).

Table 2. Regression coefficients of the Logit model, 1992 and 2022

Independent variables	*1992*		*2022*	
	Coefficients	*P > |Z|*	*Coefficients*	*P > |Z|*
Constant	-0.5242	0.000***	1.1493	0.000***
Sex_head	0.2284	0.000***	0.1487	0.000***
Age_head	-0.0096	0.000***	-0.0141	0.000***
Education_head	-0.1625	0.050*	-0.4174	0.000***
Household size	-0.0785	0.000***	0.0075	0.289
Children under 12	0.3054	0.000***	0.0914	0.000***
Adults over 65	-0.0421	0.528	-0.0801	0.001***
Income earner	0.1766	0.000***	0.0701	0.000***
Quintile 2	0.5289	0.000***	0.2612	0.000***
Quintile 3	0.6776	0.000***	0.4783	0.000***
Quintile 4	0.8957	0.000***	0.6490	0.000***
Quintile 5	0.8446	0.000***	0.6199	0.000***
Urban	0.2993	0.000***	-0.0148	0.375
Sample	10 530		90 102	
Chi-square (P-value)	694.43 (0.000)***		3 273.33 (0.000)***	
McFadden's R^2	0.0475		0.0307	
Log-likelihood	-6 949.15		-51 508.06	
Correctly predicted cases (%)	6 407 (60.8%)		65 248 (72.4%)	

Note: coefficients are statistically significant with a confidence level of 90% (*), 95% (**) and 99% (***).
Source: prepared by the authors using data from the ENIGH (1992 and 2022).

According to Table 2, the majority of the independent variables are statistically significant at 99% for the two years analyzed, and only the variable of the education of the head of the household showed 90% significance for 1992. In contrast, the variable of adults over 65 years of age was not statistically significant for the first year analyzed. The same applies to household size and urban status, which were not significant for the second year studied.

Marginal effects indicate the marginal change in the probability of SSBC for a household in response to changes in the independent variables (see Table 3). For 1992, the probability of SSBC was found to be 5.7% higher in households headed by men compared with those headed by women. This probability has decreased over time, standing at 2.96% for 2022. This result is similar to that found by Malik and Hu (2022) in respect to the fact that males consumed more sugar-sweetened beverages than females in several regions of Africa, Asia, Latin America and the Caribbean. Therefore, it can be assumed that female heads of households play an important role in ensuring that their family members eat a healthy diet, seeking to reduce their intake of beverages with a high sugar content.

Table 3. Marginal effects calculated based on Logit model coefficients, 1992 and 2022

Independent variables	*1992*		*2022*	
	Marginal effect	*P > |Z|*	*Marginal effect*	*P > |Z|*
Sex_head	0.0570	0.000***	0.0296	0.000***
Age_head	-0.0024	0.000***	-0.0027	0.000***
Education_head	-0.0406	0.050*	-0.0871	0.000***
Household size	-0.0196	0.000***	0.0014	0.289
Children under 12	0.0762	0.000***	0.0179	0.000***
Adults over 65	-0.0105	0.528	-0.0159	0.001***
Income earner	0.0441	0.000***	0.0137	0.000***
Quintile 2	0.1302	0.000***	0.0494	0.000***
Quintile 3	0.1653	0.000***	0.0875	0.000***
Quintile 4	0.2146	0.000***	0.1155	0.000***
Quintile 5	0.2027	0.000***	0.1106	0.000***
Urban	0.0747	0.000***	-0.0029	0.375

Note: Marginal effects are statistically significant at a confidence level of 90% (*), 95% (**) and 99% (***).

Source: Prepared by the authors using data from the ENIGH (1992 and 2022).

According to the marginal effect associated with the age of the head of the household, there is an inverse relationship with the probability of SSBC. It was found that for each additional year of age, starting from the average age (41), the probability of consumption decreased by 2.4% in 1992, while this probability was 2.7% in 2022. This result is in line with the empirical evidence of Cuy Castellanos and Miller (2020), who suggest that as a person ages, they begin to be more concerned about good nutrition and a balanced diet. Thus, it can be said that an increase in the age of the head of the household favors good choices in the goods purchased and consumed, reducing the consumption of sugar-sweetened beverages because they are considered harmful to health.

Along the same lines, the educational level of the head of the household has a negative impact on the probability of SSBC. According to the marginal effect of this variable for 1992, households whose head had higher education, such as a bachelor's or postgraduate degree, were 4.06% less likely to consume sugar-sweetened beverages than households whose head had a lower level of education. The inverse effect of the level of education of the household head on the probability of SSBC doubled in 30 years, reaching 8.71% in 2022. This result is consistent with the assumption that the higher the educational level of the mother or father, the more likely they are to have more information about which beverages are or are not beneficial to human health, thereby reducing the probability of SSBC.

With regard to household size, the marginal effect in 1992 indicates that for each member added to the household, based on the average (five persons), the probability of SSBC decreased by 1.96%. This result is different from what was expected, which is that the larger the family, the higher the consumption. This may be due to the fact that the

cost of meeting the basic needs of a household rises when there are several members, limiting the economic resources available to purchase non-basic goods such as sugar-sweetened beverages. However, by 2022, although not statistically significant, it was observed that the addition of a new member to the household led to an increase in the probability of SSBC, similar to what was shown for Ethiopia (Hone and Marisennayya, 2019) and for the province of Jakarta in Indonesia (Gozali *et al.*, 2023).

Furthermore, the presence of at least one child under the age of 12 in the household increases the probability of SSBC compared to households without children, although this probability decreases from year to year, falling from 7.62% in 1992 to 1.79% in 2022. In this respect, Alemán-Castillo *et al.* (2019) point out that juice and soft drink consumption is more frequent among children when they attend school, specifically during recess. In addition, it has been found that minors tend to increase their intake of sugar-sweetened beverages and reduce their consumption of fruits and vegetables (Tasevska *et al.*, 2017). Among the factors that influence a greater taste and preference for beverages with high sugar content among children are the promotional campaigns that the beverage industry gears toward this age group (Alcaraz *et al.*, 2023).

Based on the marginal effect of the variable of household members over 65 years of age, there is an indirect relationship with the likelihood of SSBC. Only for the second year analyzed was it statistically corroborated that a household with elderly adults was 1.59% less likely to consume SSB compared to a household without elderly adults. This result coincides with the work of Meza-Miranda *et al.* (2021), which analyzed 12 Latin American countries (Argentina, Chile, Colombia, Costa Rica, Ecuador, Spain, Guatemala, Mexico, Peru, Paraguay, Panama, and Uruguay) and found that, during the Covid-19 lockdown, adults aged 60 and over had a lower SSBC compared to other younger age groups.

In relation to household economic variables, a significant positive relationship was observed between the number of employed income earners and the probability of SSBC. In other words, an additional member of the household with paid employment increased the probability of SSBC by 4.41% in 1992. Three decades later, in 2022, this probability fell to 1.37%. Meanwhile, the marginal effects related to income quintiles indicate that households classified in quintiles 2 to 5 have a higher probability of SSBC compared to households in quintile 1. This probability increases progressively as the household moves up to a higher income quintile; specifically, in 1992, households in quintile 5 were 20.27% more likely to participate in SSBC compared to those in the lowest income quintile, quintile 1. It should be noted that these marginal effects were reduced by half in 2022. In general, these results are consistent with those of Gerónimo (2024), who found that cola soft drinks, one of the most consumed beverages, tend to behave like basic goods for Mexican families, i.e., when a household increases its income, the consumption of these beverages also increases, albeit to a lesser extent.

Finally, opposite marginal effects were found between 1992 and 2022 in relation to the influence of geographical location (urban vs. rural) on the probability of SSBC. In 1992, urban households were 7.47% more likely to engage in SSBC than rural households. This result is consistent with previous studies by Sánchez-Pimienta *et al.* (2016) for Mexico and Pengpid and Peltzer (2019) for South Africa, where urban residents consumed a higher volume of sugar-sweetened beverages compared to those in rural areas. Although not statistically significant, the marginal effect of 2022 suggests that living in rural areas could increase the probability of SSBC, indicating a transformation in consumption habits and preferences in these areas, especially an increase in soft drink consumption (Wattelez *et al.*, 2019).

5. CONCLUSIONS

The central premise of this research is that sociodemographic and economic factors influence the likelihood of SSBC in Mexican households. Based on the descriptive analysis, three main results were obtained: first, cola and flavored soft drinks were identified as the most consumed beverages, with a 4.15% decrease in intake between 1992 and 2022, although average consumption remains high (5 liters per week per household). Second, packaged juices and nectars saw the largest reduction in intake with this trend being attributed to households opting for other beverages. The intake of mineral water, quinine water, demineralized water with or without flavor, as well as prepared water, natural juices and energy drinks increased, gaining ground in consumer preferences in 2022. Third, it was found that the average consumption of soft drinks, juices and packaged nectars tends to increase when households move into higher income quintiles. However, there are changes in consumption between the different quintiles; on the one hand, households with higher incomes (quintile 5) have reduced their consumption of soft drinks and juices, while households with lower incomes (quintiles 1 and 2) have increased their consumption of these beverages between the two years analyzed.

The econometric analysis divided the explanatory variables for the probability of SSBC into four categories. First, it was found that heads of households play an important role in decisions concerning the beverages consumed in the household. In this respect, it was observed that when a man is the head of the household, there is a higher probability of SSBC compared to a female head of the household. On the other hand, as the age and education of the head of the household increases and they have a bachelor's or postgraduate degree, the probability of SSBC tends to decrease. Education has emerged as a relevant factor in the probability of SSBC as its influence has increased over time, making it a key variable in promoting healthy habits, reducing sugar-sweetened beverage consumption and improving the nutritional quality of the diet of household members.

The second category includes the characteristics of household members. We can see that the presence of people over 65 years of age reduces the probability of SSBC; conversely, when there is at least one child in the household, this probability increases. The third category includes the variables: number of income earners and income quintile, both of which have a positive impact on the probability of consuming beverages with high sugar content, with income being the most important factor in terms of its level of impact on this likelihood. The fourth category of variables indicates that the probability of SSBC is increasingly less determined by geographical context, suggesting that beverage consumption patterns tend to be similar between urban and rural households.

It should be noted that the main limitation of this study is that the inferences are made at the household level since the information used from the ENIGH does not allow for knowledge of the beverage intake of each household member. Therefore, it is difficult to identify whether or not consumption is adequate since intake is not evaluated in relation to individual characteristics such as weight, height and physical activity. The second limitation is that the relationship between sociodemographic and economic variables and sugar-sweetened beverages was determined in aggregate form; the effects would probably be different if the estimate were carried out according to type of beverage. Likewise, estimates of SSBC may differ from those of other studies since the data used comes from secondary sources.

Finally, this paper may be useful for designing public policies that promote healthy eating. First, educational campaigns should be implemented targeting heads of households, as they are the ones who exert the most influence on family consumption decisions. These campaigns can be developed together with the Ministry of Public Education and the Ministry of Health in order to reduce SSBC. Second, coordinated strategies should be implemented among the three levels of government to restrict the promotion and advertising of sugar-sweetened beverages that have been targeted at minors in order to reduce the consumption of these beverages.

ACKNOWLEDGEMENTS

This research was made possible thanks to the support of the Antonio Narro Autonomous Agrarian University through the research project “Tendencia del CBA en los hogares de México” (SSBC trends in Mexican households), code number: 38111-425302001-2250.

BIBLIOGRAPHY

Alcaraz, A., Perelli, L., Rodríguez, M., Palacios, A., Bardach, A., Gittens-Baynes, K., Vianna, C., Guevara, G., García-Martí, S., Ciapponi, A., Augustovski, F., Belizán, M. and Pichon-Riviere, A. (2023). ¿Qué necesita nuestra región para fortalecer políticas públicas sobre bebidas azucaradas? diálogo de decisores. *Revista Peruana de Medicina Experimental y Salud Pública, 40(1).* https://dx.doi.org/10.17843/rpmesp.2023.401.12394

Alemán-Castillo, S., Castillo-Ruíz, O., Bacardí-Gascón, M. and Jiménez-Cruz, A. (2019). Alimentos seleccionados por los padres para los refrigerios de sus hijos en etapa de educación básica en Reynosa, Tamaulipas. *CienciaUAT, 14(1).* https://doi.org/10.29059/cienciauat.v14i1.1268

Alfaris, N. A., Alshwaiyat, N. M., Alkhalidy, H., AlTamimi, J. Z., Alagal, R. I., Alsaikan, R. A., Alsemari, M. A., BinMowyna, M. N. and AlKehayez, N. M. (2022). Sugar-sweetened beverages consumption in a multi-ethnic population of middle-aged men and association with sociodemographic variables and obesity. *Frontiers in Nutrition, 9.* https://doi.org/10.3389/fnut.2022.987048

Al-Hanawi, M. K., Ahmed, M. U., Alshareef, N., Qattan, A. M. N. and Pulok, M. H. (2022). Determinants of sugar-sweetened beverage consumption among the Saudi adults: findings from a nationally representative survey. *Frontiers in Nutrition, 9.* https://doi.org/10.3389/fnut.2022.744116

Barquera, S., Hernandez-Barrera, L., Tolentino, M. L., Espinosa, J., Ng, S. W., Rivera, J. A. and Popkin, B. M. (2008). Energy intake from beverages is increasing among Mexican adolescents and adults. *The Journal of Nutrition, 138(12).* https://doi.org/10.3945/jn.108.092163

Bergallo, P., Castagnari, V., Fernández, A. and Mejía, R. (2018). Regulatory initiatives to reduce sugar-sweetened beverages (SSBS) in Latin America. *PloS One, 13(10).* https://doi.org/10.1371/journal.pone.0205694

Braverman-Bronstein, A., Camacho-García-Formentí, D., Zepeda-Tello, R., Cudhea, F., Singh, G. M., Mozaffarian, D. and Barrientos-Gutierrez, T. (2020). Mortality attributable to sugar sweetened beverages consumption in Mexico: an update. *International journal of obesity, 44(6).* https://doi.org/10.1038/s41366-019-0506-x

Colchero, M. A., Rivera-Dommarco, J., Popkin, B. M. and Ng, S. W. (2017). In Mexico, evidence of sustained consumer response two years after implementing a sugar-sweetened beverage tax. *Health Affairs (Project Hope), 36(3).* https://doi.org/10.1377/hlthaff.2016.1231

Cuy Castellanos, D. and Miller, M. (2020). Exploration of sugar-sweetened beverage intake in a latinx population. *Journal of Nutrition Education and Behavior, 52(3).* https://doi.org/10.1016/j.jneb.2019.08.013

Farsad-Naeimi, A., Asjodi, f., Omidian, M., Askari, M., Nouri, M., Pizarro, A. B. and Daneshzad, E. (2020). Sugar consumption, sugar sweetened beverages and Attention Deficit Hyperactivity Disorder: a systematic review and meta-analysis. *Complementary Therapies in Medicine, 53.* https://doi.org/10.1016/j.ctim.2020.102512

Federal Consumer Protection Agency (PROFECO) (2023). Refrescos. Más información menos azúcares. *Revista del Consumidor, 555.* https://www.profeco.gob.mx/revista/RevistaDelConsumidor_555_MAYO_2023.pdf

Food and Agriculture Organization of the United Nations (FAO) (2018). *Panorama de la seguridad alimentaria y nutricional en América Latina y el Caribe 2018.* https://iris.paho.org/handle/10665.2/49616

_____ (2021). Frutas y verduras-esenciales en tu dieta. Año Internacional de las Frutas y Verduras. Documento de antecedentes. https://doi.org/10.4060/cb2395es

Gerónimo, V. (2024). Estimación de un modelo de demanda de refrescos en México, 1922 y 2022. In F. Pérez, E. Figueroa, P. Escamilla, R. Pérez, L. Godínez and A. Gallegos (comps.). *Búsqueda de la eficiencia económica* (pp. 46-56). Universidad Autónoma Chapingo.

Gozali, M., Candra, A. and Bagus, N. (2023). The socio-economic factors influencing Sugar-Sweetened Beverages (SSB's) consumption in household of DKI Jakarta Province in 2020. *Proceedings of The International Conference on Data Science and Official Statistics, 2023(1).* https://doi.org/10.34123/icdsos.v2023i1.300

Greene, W. (2012). *Econometric Analysis.* Pearson Education.

Hone, Z. and Marisennayya, S. (2019). Determinants of household consumption expenditure in Debremarkos town, Amhara Region, Ethiopia. American Scientific *Research Journal for Engineering, Technology, and Sciences, 62(1).* https://core.ac.uk/download/pdf/276539534.pdf

Instituto Nacional de Estadística y Geografía (INEGI) (1992). Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH), 1992. https://www.inegi.org.mx/programas/enigh/tradicional/1992/

_____ (2022). Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH), 2022. https://www.inegi.org.mx/programas/enigh/nc/2022/

_____ (2023). Glosario. https://www.inegi.org.mx/app/glosario/default. html?p=ENCIG2023

Lara-Castor, L., Micha, R., Cudhea, f., Miller, V., Shi, P., Zhang, J., Sharib, J. R., Erndt-Marino, J., Cash, S. B., Mozaffarian, D. and Global Dietary Database (2023). Sugar-sweetened beverage intakes among adults between 1990 and 2018 in 185 countries. *Nature Communications, 14(1).* https://doi.org/10.1038/s41467-023-41269-8

Li, B., Yan, N., Jiang, H., Cui, M., Wu, M., Wang, L., Mi, B., Li, Z., Shi, J., fan, Y., Azalati, M. M., Li, C., Chen, f., Ma, M., Wang, D. and Ma, L. (2023). Consumption of sugar sweetened beverages, artificially sweetened beverages and fruit juices and risk of type 2 diabetes, hypertension, cardiovascular disease, and mortality: A meta-analysis. *Frontiers in Nutrition, 10.* https://doi.org/10.3389/fnut.2023.1019534

Llamas, I., Charles, H. and Aboites, G. (2012). Gasto en alimentos y bebidas fuera del hogar: El caso de México, 1992 y 2008. *Economía: Teoría y Práctica, (37).* http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0188-33802012000200008&lng=es&tlng=es

Lozano, C., Calvo, G., Armenta, C. and Pardo, R. (2021). La influencia de los grupos sociales en la alimentación de estudiantes universitarios mexicanos. *Psicumex, 11.* https://doi.org/10.36793/psicumex.v11i1.346

Malhotra, N. K. (1984). The use of linear Logit Models in marketing research. *Journal of Marketing Research, 21(1).* https://doi.org/10.1177/002224378402100103

Malik, V. S. and Hu, f. B. (2022). The role of sugar-sweetened beverages in the global epidemics of obesity and chronic diseases. Nature Reviews. *Endocrinology, 18(4).* https://doi.org/10.1038/s41574-021-00627-6

Meza-Miranda, E., Núñez-Martínez, B., Durán-Agüero, S., Pérez-Armijo, P., Martin-Cavagnari, B., Cordón-Arrivillaga, K., Carpio-Arias, V., Nava-González, E., Camacho-López, S., Ivankovich-Guilén, S., Ríos-Castillo, I., González-Medina, G.,

Bejarano-Roncancio, J., Ortíz, A., Mauricio-Alza, S. and Landaeta-Díaz, L. (2021). Consumo de bebidas azucaradas durante la pandemia por Covid-19 en doce países iberoamericanos: un estudio transversal. *Revista Chilena de Nutrición, 48(4).* https://dx.doi.org/10.4067/S0717-75182021000400569

Ministry of the Economy (SE) (2020, March 27). Modification to Mexican Official Standard NOM-051-SCFI/SSA1-2010. General labeling specifications for prepackaged food and non-alcoholic beverages - Commercial and Sanitary Information. *Official Journal of the Federation.* https://dof.gob.mx/2020/SEECO/NOM_051.pdf

Muñiz, P. and Hernández, D. (1999). Los atributos de la jefatura del hogar. *Estudios Demográficos y Urbanos, 14(2).* https://doi.org/10.24201/edu.v14i2.1049

Muth, N. D., Dietz, W. H., Magge, S. N., Johnson, R., Bolling, C., Armstrong, S., Haemer, M., Rausch, C., Weeks, V., Abrams, S., Kim, J., Schwarzenberg, S., Fuchs, J., Lindsey, C. and Rome, E. (2019). Public policies to reduce sugary drink consumption in children and adolescents. *Pediatrics, 143(4).* https://doi.org/10.1542/peds.2019-0282

Pan American Health Organization (PAHO) (2015). Taxes on sugar-sweetened beverages as a public health strategy: the experience of Mexico. https://iris.paho.org/handle/10665.2/18391

Pengpid, S. and Peltzer, K. (2019). Prevalence and socio-behavioral factors associated with sugar-sweetened beverages consumption among 15 years and older persons in South Africa. *Diabetes, metabolic syndrome and obesity: targets and therapy, 12.* https://doi.org/10.2147/DMSO.S209147

Popkin, B. M. and Reardon, T. (2018). Obesity and the food system transformation in Latin America. *Obesity Reviews, 19(8).* https://doi.org/10.1111/obr.12694

Purohit, B. M., Dawar, A., Bansal, K., Nilima, Malhotra, S., Mathur, V. P. and Duggal, R. (2023). Sugar-sweetened beverage consumption and socioeconomic status: a systematic review and meta-analysis. *Nutrition and Health, 29(3).* https://doi.org/10.1177/02601060221139588

Raiteri, M. (2015). *El comportamiento del consumidor actual* [Tesis de grado, Universidad Nacional de Cuyo]. https://bdigital.uncu.edu.ar/8046

Sánchez-Pimienta, T. G., Batis, C., Lutter, C. K. and Rivera, J. A. (2016). Sugar-sweetened beverages are the main sources of added sugar intake in the Mexican population. *The Journal of Nutrition, 146(9).* https://doi.org/10.3945/jn.115.220301

Santana-Jiménez, M. A., Nieves-Barreto, L. D., Montaño-Rodríguez, A., Betancourt-Villamizar, C. and Mendivil, C. O. (2023). Consumption of sugary drinks among urban adults in Colombia: association with sociodemographic factors and body adiposity. *International Journal of Environmental Research and Public Health, 20(4).* https://doi.org/10.3390/ijerph20043057

Schneider, S., Mata, J. and Kadel, P. (2020). Relations between sweetened beverage consumption and individual, interpersonal, and environmental factors: a 6-year longitudinal study in German children and adolescents. *International Journal of Public Health, 65(5).* https://doi.org/10.1007/s00038-020-01397-0

Sosa, C. E. and Mancera, O. (2022). Análisis estadístico sobre el consumo de refrescos y sus implicaciones sociales y económicas en Sinaloa, México. Un caso de estudio para estudiantes universitarios de pregrado. *Interdisciplina, 10(27).* https://doi.org/10.22201/ceiich.24485705e.2022.27.82158

Tasevska, N., DeLia, D., Lorts, C., Yedidia, M. and Ohri-Vachaspati, P. (2017). Determinants of sugar-sweetened beverage consumption among low-income children: are there differences by race/ethnicity, age, and sex? *Journal of the Academy of Nutrition and Dietetics, 117(12).* https://doi.org/10.1016/j.jand.2017.03.013

Tojo, R. (2003). Consumo de zumos de frutas y de bebidas refrescantes por niños y adolescentes en España. Implicaciones para la salud de su mal uso y abuso. *Anales de Pediatría, 58(6).* https://doi.org/10.1016/S1695-4033(03)78126-0

Varian, H. (2022). *Microeconomía Intermedia. Un enfoque actual*. Antoni Bosch Editor.

Wattelez, G., Frayon, S., Cavaloc, Y., Cherrier, S., Lerrant, Y. and Galy, O. (2019). Sugar-sweetened beverage consumption and associated factors in school-going adolescents of New Caledonia. *Nutrients, 11(2).* https://doi.org/10.3390/nu11020452

Wooldridge, J. M. (2010). *Introducción a la econometría. Un enfoque moderno.* Cengage Learning.

World Health Organization (WHO) (2015). Guideline: sugars intake for adults and children. https://www.who.int/publications/i/item/9789241549028