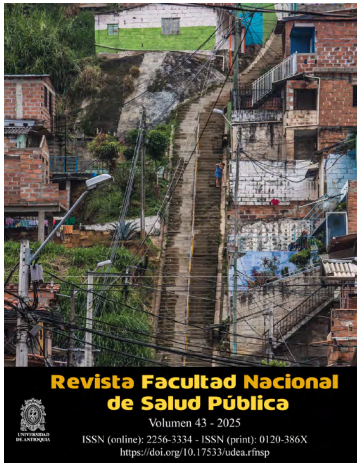




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Factors related to the consumption of sugar-sweetened beverages in children and adolescents in Colombia: A cross-sectional analysis

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Abstract

Objective: To determine the sociodemographic, economic, and behavioral factors related to sugar-sweetened beverage consumption in children aged 5 to 17 years in Colombia.

Methods: Cross-sectional study using the database of the 2022 National Quality of Life Survey carried out in Colombia. 55,396 records of children aged 5 to 17 were included; they were selected through probabilistic sampling. The relationship between the variables and sugar-sweetened beverage consumption was analyzed with Poisson regression models, sensitivity analysis, and multivariate regression models.

Results: The prevalence of sugar-sweetened beverage consumption is 75.86%. This consumption grows between 0.5% and 0.6% with increasing age (aOR = 1.005; 95% CI = 1.003–1.006). Packaged food intake raises sugar-sweetened beverage consumption between 52% and 57% (aOR = 1.55; 95% CI = 1.52–1.57). People living in the Central and Pacific regions consume less sugar-sweetened beverages, between 4% (aOR = 0.98; 95% CI = 0.96–1.00) and 6% (aOR = 0.97; 95% CI = 0.94–0.99), than those who live in the Orinoquia-Amazonia region.

Conclusion: The results highlight the importance of taking into account sociodemographic and behavioral characteristics when designing public health programs and policies, which is essential to counter the high prevalence of sugar-sweetened beverage consumption among children and adolescents in Colombia.

-----**Keywords:** sugar-sweetened beverages, risk factors, childhood and adolescence, measures of association, exposure, risk or outcome

Factores relacionados con el consumo de bebidas azucaradas en niños y adolescentes en Colombia: un análisis transversal

Resumo

Objetivo: Determinar os fatores sociodemográficos, econômicos e comportamentais relacionados com o consumo de bebidas açucaradas em menores de 5 a 17 anos na Colômbia.

Métodos: Estudo de corte transversal, a partir da base de dados da Enquete Nacional de Qualidade de Vida, da Colômbia, do ano 2022. Incluíram-se 55 396 registros de menores entre 5 e 17 anos, selecionados por meio de desenho amostral probabilístico. A relação entre as variáveis e o consumo de bebidas açucaradas foi analisada por meio de modelos de regressão de Poisson, análise de sensibilidade e modelos de regressão multivariada.

Resultados: A prevalência de consumo de bebidas açucaradas é de 75,86 %. Seu consumo aumenta entre 0,5 e 0,6 % com aumento da idade (RDa = 1,005; IC 95 % = 1,003-1,006). A ingestão de alimentos ultraprocessados incrementa a ingestão de bebidas açucaradas entre 52 e 57% (RDa = 1,55; IC 95 % = 1,52-1,57). As pessoas que moram nas zonas Central e Pacífica têm menor consumo, entre 4% (RDa = 0,98; IC 95 % = 0,96-1,00) e 6% (RDa = 0,97; IC 95 % = 0,94-0,99) em comparação com aquelas que moram na Orinoquia-Amazônia.

Conclusão: Os resultados destacam a importância de considerar as características sociodemográficas e de comportamento no desenho de políticas e programas de saúde pública, o que resulta essencial para neutralizar a alta prevalência de consumo de bebidas açucaradas em infantes e adolescentes na Colômbia.

-----*Palavras-chave:* bebidas açucaradas, fatores de risco, infância e adolescência, medidas de associação, exposição, risco e desenlace..

Fatores relacionados com o consumo de bebidas açucaradas em crianças e adolescentes na Colômbia: uma análise transversal

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Introduction

Sugar-sweetened beverages (SSBs) are defined as those containing added sugars. This category includes carbonated soft drinks, fruit juices, energy and sports drinks, teas, and milk drinks, among others [1]. The production and consumption of these products represent a global health problem that needs to be addressed, controlled, and countered as part of the Sustainable Development Goals, specifically goal 3, “Health and Well-being” [2].

SSB consumption has become a significant public health problem, given its adverse effects on health, particularly among minors, related to the development of chronic noncommunicable diseases (NCDs). This issue is therefore a cause for concern worldwide [3]. In this regard, a global investigation was carried out in 107 countries, with more than 400000 adolescents participating. The investigation found that daily intake of SSB is significantly associated with overweight and obesity. It has been estimated that reducing the consumption of these beverages could contribute to a reduction in obesity rates among adolescents, and therefore to the prevention of NCDs related to this condition [4].

In contrast, high consumption of SSB has a detrimental effect on health, as well as resulting in social, cultural, economic, political, and environmental consequences.

It is estimated that one in every 100 deaths due to NCDs is attributable to the consumption of these beverages [5]. Furthermore, there is a growing body of evidence to suggest that the intake of these substances by adolescents aged 12 to 18 years is associated with an increased risk of developing mental health disorders, such as sleep disturbances, aggressive behaviors, anxiety, depression, and even an increased risk of suicide attempts [6-8].

In adolescence, the consumption of SSB is driven by a combination of factors, including the need to satisfy cravings, reduce fatigue, and facilitate social interaction. Research has shown that intake of these beverages increases in contexts where they are readily available [9]. Research indicates that this consumption is higher among young people residing in urban areas and families with greater purchasing power [10]. In Latin America, sales of ultra-processed products, including SSB, have doubled [11].

The prevalence of SSB consumption among adolescents is a significant issue. A study that included 185 countries revealed that the average consumption in Latin America is 1.15 servings per day, with Mexico leading the region with 562 mL/day, followed by Suriname and Jamaica at 444 mL/day. In Colombia, the average intake is 296 mL/day, with a higher prevalence among young people from urban areas and those with a higher level of education [12].

According to the 2010 National Survey of the Nutritional Situation in Colombia (ENSIN), there was a SSB consumption prevalence of 81.2%, of which 22.1% reported once daily intake; 49.4%, weekly; and 9.7%, monthly [13]. This trend has increased in recent years, reaching 85.4%, with a frequency of consumption of at least once a day, according to data reported by the National Survey of Nutritional Status, 2015 [14].

In consideration of this problem, several countries have implemented public health policies and strategies to improve nutritional health and prevent diseases associated with the consumption of SSB, such as obesity, diabetes, cardiovascular diseases, and other NCDs.

The World Health Organization (WHO) has recommended that governments consider selective taxes on SSB as an effective strategy to reduce consumption. This reduction could contribute to a decline in the prevalence of associated NCDs, leading to a positive financial impact on the General Social Security Health System by reducing the costs of treating and managing these pathologies [16]. Furthermore, imposing a tax on these products has the potential to indirectly promote greater health equity.

Similarly, the Sustainable Development Agenda includes objectives to improve nutrition, reduce obesity, and premature mortality due to NCDs [17]. Obesity is a multifactorial problem that poses a significant public health challenge [18]. In this context, the study hypothesizes that there are sociodemographic, economic, and behavioral factors associated with the consumption of SSB in children between 5 and 17 years of age in Colombia. Analyzing these factors is essential to measure the magnitude of the problem and to guide, in a more effective way, the implementation of public health policies.

In Colombia, progress has been made in understanding the impact of this problem, although evidence remains limited. The objective of this study was to determine the association between sociodemographic, economic, and behavioral factors and SSB consumption in minors. The data were obtained from the National Quality of Life Survey (QLS) 2022 of the National Administrative Department of Statistics (DANE) [19]. It is vital to be aware of these factors to design effective health education intervention strategies and contribute to the effective management of public health services in the nutritional component.

Methods

A cross-sectional observational study was conducted, given that the objective was to analyze the relationships between the variables of interest in a single measure-

ment [20]. This design is appropriate, since it provides information for the formulation of public health interventions; in particular, it allows the identification of factors that may increase or decrease the probability of SSB intake in children and adolescents [21].

This study was conducted and is reported in accordance with the recommendations of the RECORD Statement (Reporting of Studies Conducted Using Routinely and Observationally Collected Health Data). [22].

The study population analyzed is derived from the 2022 Colombian LCS. The information is provided in a disaggregated form and requires consolidation in a unified base, and was consolidated using household, dwelling, and individual identifiers. The survey provides information on the socioeconomic conditions of households in the country. The study employs a probabilistic, stratified, multistage sample design by conglomerates. The sample calculation was adjusted for the non-response rate. A total of 88328 households and 251925 individuals of all ages were surveyed [19, 23].

The investigation utilized data from the health component of CVD, collected through structured interviews conducted in participants' homes. The research focused on the subgroup of minors between 5 and 17 years of age, resulting in a subgroup of 55,396 minors, based on the following questions: I would like to ask you a few questions about your dietary habits. Firstly, do you consume sugary drinks, such as soda, soft drinks, processed fruit juice drinks, sweetened tea, or powdered soft drinks? How often do you consume sugary drinks? Secondly, do you consume packaged foods, (potatoes,

plantains, chitos, mixed packages, *rosquitas*, *chicharrones* or similar)?

These questions were to be answered by all household members at the time of the survey. Responses from individuals between the ages of 12 and 17 who were either in employment or pursuing vocational education were provided directly by these respondents. For children under 12 years of age and young people between 12 and 17 years of age who were neither in employment nor education, the answers were provided by the father, mother, or responsible guardian.

In this study, the dependent variable was defined as SSB consumption (yes/no); the independent variables comprised sociodemographic conditions, including age (in years), sex (male, female), ethnicity (none, indigenous, Afro-Colombian, other -rom, palenque-), region of residence (Antioquia, Caribbean, Central, Eastern, Orinoco-Amazon, Pacific, San Andres), and area of residence (urban, rural). The data collection instrument comprises the following categories of information: educational level (none, primary, secondary); health affiliation regime (contributory, special, subsidized, don't know); provision of free food at the educational establishment (yes/no, don't report); location of the educational establishment (urban, rural, don't report); household income (low, medium, high); consumption of packaged food (yes/no).

The variables were structured by a directed acyclic diagram, following a logical temporal sequence based on the WHO social determinants of health model (see Figure 1).

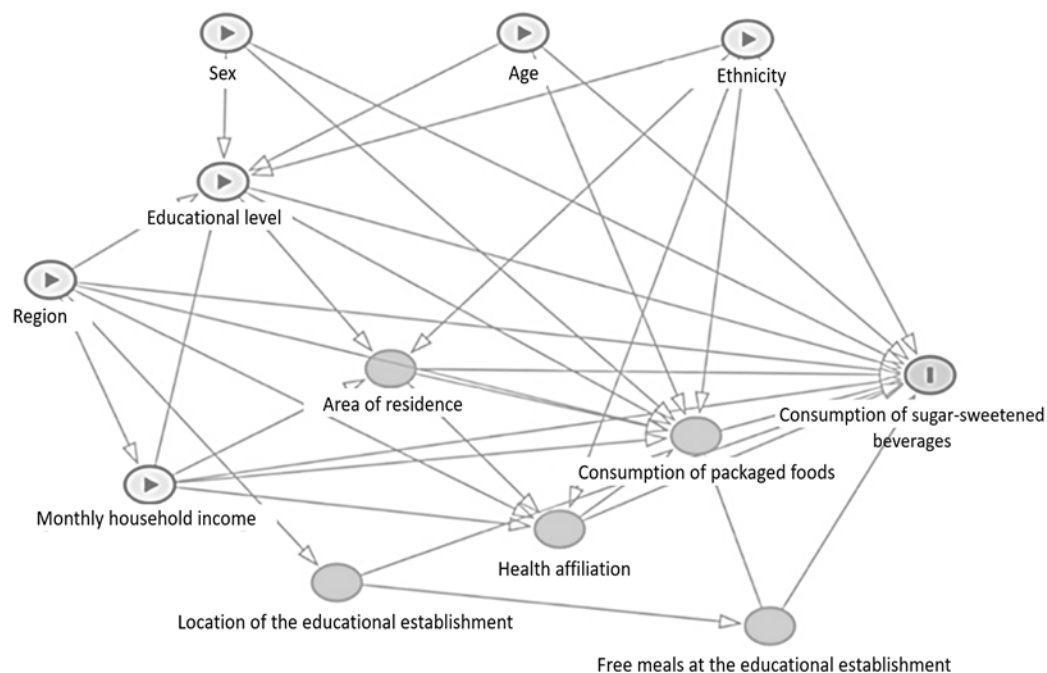


Figure 1. Directed acyclic diagram of the study variables

Initially, exploratory analysis was carried out to understand the behavior of the selected variables and to determine the pertinent statistical analyzes for the analysis of the data. We then went on to characterize the population studied as a whole and in subgroups differentiated by SSB consumption.

Absolute and relative frequencies were calculated for qualitative variables such as sex, ethnicity, area and region of residence, health affiliation, educational level, provision of free food in educational institutions, location of the educational establishment, and consumption of packaged food. The distribution of the age variable was explored using the Kolmogorov-Smirnov test. This revealed that the distribution was not normally distributed. Therefore, the median and interquartile range were reported.

Given the prevalence of SSB consumption in each category and the study design, a Poisson regression analysis with robust variance was performed, due to its precision in this type of study, which allowed direct estimates of the prevalence ratio (PR) to be obtained. Furthermore, this technique provides enhanced stability and reduced risk of convergence problems in comparison with the log-binomial regression [24]. The response variable was defined as “SSB consumption” for each of the variables included in the study. The following table presents the results of the PRs, accompanied by their respective 95% confidence intervals (95% CI). Statistical significance was set at $p < 0.05$.

Subsequently, a multivariate Poisson regression analysis with robust variance was performed between the response variable and the set of all exposure variables, reporting PRs with their respective 95% CIs. For this stage, sensitivity analyzes were performed, as they reinforce the robustness of the results, using alternative multivariate models. The study involved the construction of multivariate regression models, incorporating various variable combinations to analyze the data.

Nagelkerke's R^2 and AIC were used to identify the best-fitting model, balancing fit and complexity. Excessive complexity was penalised to avoid overfitting. The AIC was used to identify the model that offered the best balance between accuracy and parsimony. The model with the lowest AIC value among the analyzed alternatives was selected, ensuring that the findings were more robust by not relying on a single model [25]. Statistical analyzes were performed using the RStudio v2023.09.1 Build 494 program, which is available free of charge.

This study poses no risk to participants, given that the analyzes were performed from an available secondary source [23]. Furthermore, no direct intervention was made with the participants, nor does it pose any potential risks to their privacy [27]. The DANE guarantees the confidentiality of the information by anonymising the data using numerical identifiers before publication, by Law 1581 of 2012, and by ensuring that the ethical and legal principles of the research are adhered to [28].

Results

The total study population comprised 55,396 individuals between the ages of 5 and 17 years; the median age was 11 years, with an interquartile range of 8 to 14 years. Nine out of ten participants had no formal education. Most participants were affiliated with the subsidized healthcare system. Seventy percent of the participants were from low- and middle-income households. Half of the minors were residing in rural areas, and 80% of them reported consuming packaged food. It is evident that the majority of educational institutions, 54.8%, were situated within urban areas. Furthermore, it is noteworthy that 47.91% of respondents reported that their schools provided free meals. It is reported that 80% of consumers have consumed SSB. The prevalence of SSB consumption was 75.86% (see Table 1).

Table 1. Sociodemographic, economic, and behavioral characteristics of the population between 5 and 17 years of age. Colombia, 2022

Characteristics	Variable	Category	n (%)
Sociodemographic characteristics	Sex	Man	28 349 (51.18)
		Woman	27 047 (48.82)
	Age	In years	11.00 (RIC = 8.00; 14.00)
		None	41 697 (75.27)
	Ethnic recognition	Indigenous	8448 (15.25)
		Afro-Colombian	4996 (9.02)
		Other (rom the palenque)	255 (0.46)
	Educational level	None	51 561 (93.07)

Characteristics	Variable	Category	n (%)
		Primary education	1793 (3.24)
		Secondary education	2042 (3.69)
	Area of residence	Urban	28 702 (51.81)
		Rural	26 694 (48.19)
	Area where the educational establishment is located	Rural	19 436 (35.08)
		Urban	30 371 (54.83)
		No information	5589 (10.09)
	Region	Caribbean	15 195 (27.43)
		Eastern	9252 (16.70)
		Central	8440 (15.24)
		Pacífica	5714 (10.31)
		Bogotá D. C.	786 (1.42)
		Antioquia	1878 (3.39)
		Valle del Cauca	1594 (2.88)
		San Andrés	478 (0.86)
		Orinoquia-Amazonia	12 059 (21.77)
Socioeconomic characteristics	Household income	Low	20 914 (37.75)
		Middle	20 138 (36.35)
		High	14 344 (25.90)
	Free meals at the educational establishment	No	23 062 (41.63)
		Yes	26 540 (47.91)
		No information	5794 (10.46)
	Affiliation regime	Contributory	10 039 (18.12)
		Special	817 (1.57)
		Subsidized	41 493 (74.90)
Does not know		3047 (5.50)	
Behavioral characteristics	Consume packaged foods	No	16 029 (28.94)
		Yes	39 367 (71.06)
	Consume sugary beverages	No	13 374 (24.14)
		Yes	42 022 (75.86)

The prevalence of SSB consumption increases from 68% at age 9 to 80% at age 10. The latter prevalence is maintained until the age of 17 (see Figure 2).

This simple age analysis provides a more detailed and precise overview of variations in SSB consumption according to each year of age. It was found that there was a 53-57% increase in SSB intake among individuals who consumed packaged foods (PR = 1.55; 95% CI = 1.53-1.57). In addition, the study revealed that SSB consumption was 1 to 4% higher in students attending urban schools compared to their rural counterparts (PR = 1.02; 95% CI = 1.01-1.04), and there was a 1 to 3% increase in educational institutions offer-

ing free food (PR = 1.02; 95% CI = 1.01-1.03). It was found that SSB consumption increased by 1% for each year of age (PR = 1.01; 95% CI 1.01-1.01).

In economic terms, consumption is higher by 2 and 5% in middle-income households (PR = 1.04; 95% CI = 1.02-1.05) and by 3 to 7% in high-income households (PR = 1.05; 95% CI = 1.03-1.07). In terms of ethnicity, individuals who identified as Afro-Colombian demonstrated a higher intake of SSB, ranging from 5 to 10%. Finally, consumption levels in the Caribbean region are higher, ranging from 4 to 8% (PR = 1.06; 95% CI = 1.04-1.08), as outlined in Table 2.

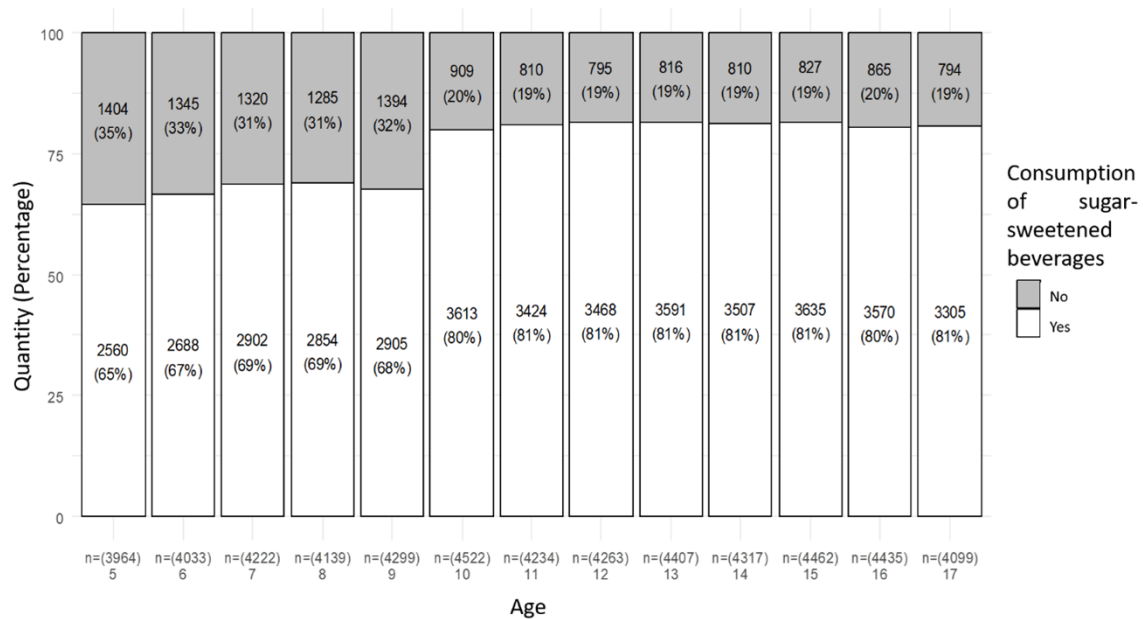


Figure 2. Prevalence of consumption of sugar-sweetened beverages by age

Table 2. Bivariate analysis: characteristics related to SSB consumption.

		Consume sugary beverages		PR (IC 95 %)	p-value
Characteristic		Yes. n = 42 022 n (%)	No. n = 13,374 n (%)		
Sex	Man	21 541 (51.26)	6808 (50.90)	Ref.	
	Woman	20 481 (48.74)	6566 (49.10)	1.00 (0.99-1.01)	0.8
Age		12.00 (8.00-15.00)a	9.00 (7.00;13.00)a	1.01 (1.01-1.01)	< 0.001
Educational level	None	39 218 (93.33)	12 343 (92.29)	Ref.	
	Primary education	1193 (2.84)	600 (4.49)	0.95 (0.91-0.98)	0.003
	Secondary education	1611 (3.83)	431 (3.22)	1.02 (0.98-1.05)	0.3
Affiliation	Contributory	7735 (18.41)	2304 (17.23)	Ref.	
	Special	660 (1.57)	157 (1.17)	1.02 (0.97-1.08)	0.4
	Subsidized	31 514 (74.99)	9979 (74.61)	0.99 (0.98-1.01)	0.5
	Unknown	2113 (5.03)	934 (6.99)	0.96 (0.93-0.99)	0.05

		Consume sugary beverages			
Characteristic		Yes. n = 42 022	No. n = 13,374	PR (IC 95 %)	p-value
		n (%)	n (%)		
Household income	Low	14 925 (35.52)	5989 (44.78)	Ref.	
	Middle	15 636 (37.21)	4502 (33.66)	1.04 (1.02-1.05)	< 0.001
	High	11 461 (27.27)	2883 (21.56)	1.05 (1.03-1.07)	< 0.001
Ethnic recognition	None	5797 (13.80)	2651 (19.82)	Ref.	
	Indigenous	32 016 (76.19)	9681 (72.39)	1.05 (1.03-1.07)	< 0.001
	Afro-Colombian	4065 (9.67)	931 (6.96)	1.08 (1.05-1.10)	< 0.001
	Other (rom the palenque)	144 (0.34)	111 (0.83)	0.93 (0.84-1.02)	0.14
Area of residence	Rural	21 053 (50.10)	7649 (57.19)	Ref.	
	Urban	20 969 (49.90)	5725 (42.81)	1.03 (1.02-1.04)	< 0.001
Consume packaged foods	No	4231 (10.07)	11 798 (88.22)	Ref.	
	Yes	37 791 (89.93)	1576 (11.78)	1.55 (1.53-1.57)	< 0.001
Free meals at the educational establishment	No	17 280 (41.12)	5782 (43.23)	Ref.	
	Yes	20 863 (49.65)	5677 (42.45)	1.02 (1.01-1.03)	0.002
	No information	3879 (9.23)	1915 (14.32)	0.95 (0.93-0.98)	< 0.001
Area where the educational establishment is located	Rural	14 493 (34.49)	4943 (36.96)	Ref.	
	Urban	23 807 (56.65)	6564 (49.08)	1.02 (1.01-1.04)	0.002
	No information	3722 (8.86)	1867 (13.96)	0.95 (0.93-0.98)	< 0.001
Region	Orinoquia-Amazonia	8683 (20.66)	3376 (25.24)	Ref.	
	Bogotá D. C.	555 (1.32)	231 (1.73)	0.99 (0.94-1.05)	0.8
	Caribbean	12 439 (29.60)	2756 (20.61)	1.06 (1.04-1.08)	< 0.001
	Eastern	6838 (16.27)	2414 (18.05)	1.01 (0.99-1.03)	0.3
	Central	6178 (14.70)	2262 (16.91)	1.01 (0.9-1.03)	0.5
	Pacific	4302 (10.24)	1412 (10.56)	1.02 (1.00-1.04)	0.12

Characteristic	Consume sugary beverages			
	Yes. n = 42 022	No. n = 13,374	PR (IC 95 %)	p-value
	n (%)	n (%)		
Antioquia	1435 (3.41)	443 (3.31)	1.03 (0.99-1.06)	0.2
Valle del Cauca	1241 (2.95)	353 (2.64)	1.03 (0.99-1.08)	0.095
San Andrés	351 (0.84)	127 (0.95)	1.01 (0.94-1.08)	0.8

^a Median (interquartile range -IQR-).

Reference (Ref.)

Two regression models were developed, considering the AIC and the R², and identifying factors that are related to SSB intake. It has been observed that the prevalence of SSB intake increases between 0.3 and 0.6% with each additional year of age (adjusted prevalence ratio -RPa- = 1.005; 95% CI = 1.003-1.006). In addition, the

consumption of packaged foods has been found to increase SSB consumption by 52-57% (RPa = 1.54; 95% CI = 1.52, 1.57). In contrast, in the Central and Pacific regions, the prevalence of intake is lower, ranging from 4% (RPa = 0.98; 95% CI = 0.96-1.00) to 6% (RPa = 0.97; 95% CI = 0.94-0.99), as shown in Table 3.

Table 3. Multivariate analysis of characteristics related to SSB consumption

Characteristic		cPR (IC 95 %)	p-value	Model 1*		Model 2**	
				aPR (IC 95 %)	p-value	aPR (IC 95 %)	p-value
Sex	Man	Ref.					
	Woman	1.00 (0.99-1.01)	0.8				
Age		1.01 (1.01-1.01)	< 0.001	1.00 (1.00-1.01)	< 0.001	1.00 (1.00-1.01)	< 0.001
Educational level	None	Ref.					
	Primary education	0.95 (0.91-0.98)	0.003				
	Secondary education	1.02 (0.9-1.05)	0.3				
Affiliation	Contributory	Ref.					
	Special	1.02 (0.97-1.08)	0.4				
	Subsidized	0.99 (0.98-1.01)	0.5				
	Does not know	0.96 (0.93-0.99)	0.005				

Characteristic		cPR (IC 95 %)	p-valor	Model 1*		Model 2**	
				aPR (IC 95 %)	p-valor	aPR (IC 95 %)	p-value
Household income	Low	Ref.		Ref.			
	Middle	1.04 (1.02-1.05)	< 0.001	1.01 (0.99-1.02)	0.3		
	High	1.05 (1.03-1.07)	< 0.001	1.01 (0.99-1.02)	0.4		
Ethnic recognition	None	Ref.		Ref.			
	Indigenous	1.05 (1.03-1.07)	< 0.001	0.99 (0.97-1.01)	0.6		
	Afro-Colombian	1.08 (1.05-1.10)	< 0.001	1.00 (0.97-1.03)	0.9		
	Other (from the palenque)	0.93 (0.84-1.02)	0.14	0.94 (0.83-1.07)	0.4		
Area of residence	Rural	Ref.		Ref.			
	Urban	1.03 (1.02-1.04)	< 0.001	1.00 (0.99-1.02)	0.7		
Consume packaged foods	No	Ref.		Ref.		Ref.	
	Yes	1.55 (1.53-1.57)	< 0.001	1.54 (1.52-1.57)	< 0.001	1.55 (1.52-1.57)	< 0.001
Free meals at the educational establishment	No	Ref.		Ref.			
	Yes	1.02 (1.01-1.03)	0.002	1.01 (1.00-1.03)	0.082		
	No information	0.95 (0.93-0.98)	< 0.001	1.01 (0.91-1.12)	0.8		
Area where the educational establishment is located	Rural	Ref.		Ref.			
	Urban	1.02 (1.01-1.04)	0.002	1.00 (0.98-1.02)	0.8		
	No information	0.95 (0.93-0.98)	< 0.001	0.99 (0.89-1.10)	0.8		
Region	Orinoquia-Amazonia	Ref.		Ref.		Ref.	
	Bogotá D.C.	0.99 (0.94-1.05)	0.8	0.95 (0.90-1.00)	0.07	0.95 (0.90-1.01)	0.081
	Caribbean	1.06 (1.04-1.08)	< 0.001	1.00 (0.98-1.02)	0.9	1.00 (0.98-1.02)	> 0.900
	Eastern	1.01 (0.99-1.03)	0.3	0.99 (0.97-1.01)	0.3	0.99 (0.97-1.01)	0.3
	Central	1.01 (0.99-1.03)	0.5	0.98 (0.95-1.00)	0.035	0.98 (0.96-1.00)	0.024

Characteristic	cPR (IC 95 %)	p-valor	Model 1*		Model 2**	
			aPR (IC 95 %)	p-valor	aPR (IC 95 %)	p-value
Pacific	1.02 (1.00-1.04)	0.12	0.96 (0.94-0.99)	0.01	0.97 (0.94-0.99)	0.005
Antioquia	1.03 (0.99-1.06)	0.2	0.98 (0.94-1.01)	0.2	0.98 (0.94-1.01)	0.2
Valle del Cauca	1.03 (0.99-1.08)	0.095	0.97 (0.93-1.01)	0.2	0.97 (0.94-1.01)	0.2
San Andrés	1.01 (0.94-1.08)	0.8	1.00 (0.92-1.09)	> 0.900	0.98 (0.91-1.05)	0.5

*Model 1: Akaike's information criterion (AIC): 139.750; Nagelkerke's R²: 0.535

** Model 2: Akaike's information criterion (AIC) = 139.736; Nagelkerke's R²: 0.534

Ref: Reference; aPR: Adjusted prevalence ratio; cPR: Crude prevalence ratio.

Discussion

The objective of this study was to determine the socio-demographic, economic, and behavioral factors related to the consumption of SSB in children between 5 and 17 years of age in Colombia. The research revealed a notable trend in the consumption of SSB: 4 out of 5 people respondents acknowledged their intake, indicating that they have become a crucial component of the diet. It is important to note that SSB intake among the child and adolescent population is rooted in broader food systems that are influenced by many individual, social, community, and macro-systemic factors [29]. Similar findings were reported in Canada, where 84% of adolescents reported consumption of this type of beverage. In addition, a median SSB intake of approximately two times per week was identified for boys, whereas for girls, a lower frequency was reported, with less than one time per week [30].

Other studies have detailed the frequency of consumption, for instance, the research in Colombia by Ramirez-Velez *et al.*, who showed that around 23% of the subjects reported consuming SSB at least once a week [31]. This behavior is of concern as it suggests that dietary habits established in childhood may become long-term dietary patterns. In this regard, research has indicated that adolescents who consume SSB daily are more likely to develop various forms of childhood obesity [33], type 2 diabetes, and hypertension [19]. Furthermore, it has been demonstrated that SSB consumption has a detrimental effect on cognitive function [34, 35].

The present study reports an increase in the prevalence of SSB intake with age. These results are consistent with those reported by Doggui *et al.* [36]. This

relationship has been previously identified and is partly attributed to factors such as increasing independence in decision-making, exposure, and greater influence of the environment [37, 38]. Furthermore, evidence has been presented that indicates that residing in urban areas is associated with a higher prevalence of SSB consumption. It is known that these products are more readily available and accessible in urban areas. This observation is in agreement with what has been reported in other studies [31,39]. However, rural populations face a number of the same health challenges as urban populations, and generally face additional burdens [40]. It is therefore advisable to implement inclusive public policies that take into account the particularities of both populations.

Another relevant aspect of this study is the association between the consumption of packaged foods and the increase in SSB intake. This behavior could affect children's nutritional status, as their nutritional intake is reduced. Nutrition is a key factor in the growth and development of children of this age [41,42].

However, it has been noted that the consumption of this type of food, beyond parental restrictions, is strongly influenced by its availability in the environments where it interacts. In this regard, the social environment exerts a significant influence on dietary practices [43,44]. The study by Pereira-Chaves *et al.* demonstrates that the educational environment plays a significant role in the adoption of healthy behaviors [45]. Access to vending machines in academic institutions is associated with higher consumption of beer and ale [46, 47].

In this regard, the United Nations Educational, Scientific and Cultural Organization and WHO recommend transforming unhealthy eating habits in educational settings to improve the nutritional health of children

[48]. Similarly, the recommendation to implement SSB taxes as a preventative measure against NCDs in children and adults was supported by a significant body of evidence [49, 50]. It has also been reported that the implementation of these strategies has yielded positive results in terms of reducing healthcare costs [51].

In Colombia, public health strategies related to food have been implemented. These include nutritional and front-of-food labeling [52], as well as the application of a healthy tax on some SSB and ultra-processed products. It is anticipated that these measures will influence the consumption patterns of SSB, consequently impacting the reduction of morbidity and mortality associated with NCDs related to the excessive intake of these products [53,54]. It is therefore recommended that evaluations of these policies be conducted in the country to analyze their effect. It is also necessary to implement other complementary strategies, such as strategies for healthy educational environments, advertising regulations, and the development of nutrition education programs. This ensures that the population understands the importance of these policies and feels motivated to modify their consumption habits, which will ultimately impact the reduction of the prevalence of chronic diseases associated with the intake of SSB and the promotion of healthy eating.

The findings of this study demonstrate that the Central and Pacific regions of the country exhibit a lower prevalence of consumption. This result partially aligns with those reported by the ENSIN, which identified the Pacific region as one of those with the lowest prevalence of consumption; however, it highlighted that the Central region, together with the Atlantic, Eastern, Bogotá and Eastern Plains regions, was associated with predisposing factors to the intake of SSB [31].

These consumption patterns are influenced by economic and cultural factors, underscoring the importance of conducting research in regions with cultural diversity, as this could be a variable impacting SSB consumption. These studies are essential for developing public health strategies that take a cultural approach to understand SSB consumption behavior by region [54].

Globally [55,56], between 1990 and 2018, the highest intake of SSB occurred in sub-Saharan Africa among people residing in rural areas, whereas in Latin America and the Caribbean, a reduction in consumption has been reported [57]. A multicentre study in 12 countries in these two regions reported that the frequency of SSB consumption was similar among different age groups. A survey revealed that 23.1% of individuals with a primary or elementary education reported excessive intake, compared to 13.4% of those with a university education. In contrast, the frequency of consumption showed no significant variations according to place of residence (urban versus rural) [58].

The evaluation of SSB consumption in CVD was limited, since the amount ingested was not considered, which restricts the possibility of deepening the analysis of consumption patterns in the population studied. While the cross-sectional design of the study facilitates the exploration of associations between variables, it is not sufficient to establish causal relationships. Furthermore, although some social, economic, and behavioral factors were explored, it is important to recognise that numerous other factors may also have had an influence and were not taken into account, because the LCA does not consider them.

Despite these limitations, the study provides valuable information on the factors that may influence the intake of SSB in the 5-17 age group. It can support the development of intervention strategies, policies, plans, and public health programmes to improve the health of this age group.

It is particularly important to recognise these factors when analysing the context in which minors develop and interact, as they may or may not be promoters of health [59,60]. Therefore, it is vital to understand these factors to which they are exposed to demonstrate the need to carry out public health strategies with a broader and more integrative approach. This approach must take into account the different determinants of health status involved in the consumption of SSB in this population.

In conclusion, the consumption of SSB in children and adolescents in Colombia is high, reaching 75.86%. This data highlights the existence of a public health challenge, which requires prompt intervention to reverse this behavior. Some factors have been identified as being closely related to this behavior, including sociodemographic, socioeconomic, and behavioral elements, such as low income, consumption of ultra-processed foods, and living in certain areas. These findings emphasize the importance of implementing public policies and complementary strategies that promote access to healthier food alternatives from childhood, especially for the most vulnerable groups. This can contribute to reducing health inequalities and mitigating the risk of NCDs associated with an unbalanced diet, thus improving the nutritional health of this population group.

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The authors declare no conflicts of interest.

Disclaimer

As authors, we declare that this manuscript honestly, accurately, and transparently collects information related to the study it reports, and that we therefore assume responsibility for what is presented in the manuscript. The authors' institutions of affiliation bear no responsibility.

Author Contribution Declaration

Maria Fernanda Acosta: contributed to the design, analysis, and interpretation of the results, and drafted and reviewed the final version of the manuscript. *Gino Montenegro*: contributed substantially to the analysis and interpretation of the data. He participated in the critical review of the manuscript and approved the final version of the submitted manuscript. *Angélica María Muñoz*: interpretation of the results, and drafted and reviewed the final version of the article.

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