

Sugar intake and early childhood caries in Cali, Colombia

Consumo de azúcar y caries de la infancia temprana en Cali, Colombia

Consumo de açúcar e cárie na primeira infância em Cali, Colômbia

Lina María Villegas Trujillo¹
Judy Elena Villavicencio Flórez²
Fanny Rios³
Adolfo Contreras Rengifo⁴

Received: August 9th, 2019

Accepted: November 3th, 2019

Published: December 15th, 2019

How to cite this article:

Villegas LM, Villavicencio J, Rios F, Contreras A. Sugar intake and early childhood caries in Cali, Colombia. *Revista Nac. Odontol.* (2019); 15(29), 1-15.
doi: <https://doi.org/10.16925/2357-4607.2019.02.11>

Artículo de investigación. <https://doi.org/10.16925/2357-4607.2019.02.11>

¹ Assistant Professor, Periodontal Medicine Group and Pediatric dentistry and Maxilar Orthophedic Research Group, Escuela de Odontología, Universidad del Valle, Cali, Colombia. Email: lina.villegas@correounivalle.edu.co

ORCID: <https://orcid.org/0000-0002-4568-6697>

² Professor and Pediatric dentistry and Maxilar Orthophedic Research Group, Escuela de Odontología, Universidad del Valle, Cali, Colombia. Email: judy.villavicencio@correounivalle.edu.co

ORCID: <https://orcid.org/0000-0003-4390-589X>

³ Dentistry, Escuela de Odontología, Universidad del Valle, Cali, Colombia. Email: famaari@yahoo.com

ORCID: <https://orcid.org/0000-0002-3873-1998>

⁴ Professor and Periodontal Medicine Group, Escuela de Odontología, Universidad del Valle, Cali, Colombia. Email: adolfo.contreras@correounivalle.edu.co

ORCID: <https://orcid.org/0000-0002-0848-659X>

Abstract

Background: The correlation between early childhood caries (ECC) and the consumption of sugar in foods and beverages in children has not yet been reported in Colombia.

Objective: To investigate ECC prevalence and consumption of sugar in foods at day-care pre-schoolers.

Design: A descriptive study was conducted with 124 children aged 3-4 years old attending three state funded childcare centres on weekdays and their feeding habits were recorded during 3 months and extrapolated to 1 year. The children ate an institutional determined menu at breakfast, lunch and two in between meals according to guidelines of the "Governmental Day Care Institution" that daily measure calories and classify food groups. After leaving the day-care premises and during the weekends, children feeding was a parenthood responsibility and by questionnaire, mother's interview and programmed home visit, the dietary habits of children during the weekends was established. The International Caries Detection and Assessment System investigated ECC prevalence.

Results: Estimated sugar consumption of children per year was 52.20 kg which is high above of WHO recommendation. Even though there is an increase of eating unhealthy food and beverage intake during weekends, the amount of sugar intake during weekdays was also high and both associates with increased dmft index. Night-time feeding bottle was also associated with ECC. Toothbrush for dental plaque control of those children was also unfair.

Conclusion: Excessive sugar intake and unfair toothbrush are important risk factor for ECC amongst Colombian young children. Colombia needs to develop and implement more strict nutritional policies to reduce children's sugar consumption, and to improve efficient and regular dental plaque control at day-care institutions and at home, to reduce ECC prevalence.

Keywords: Caries Risk, Sugar Intake; Children; Early Childhood Caries.

Resumen

Introducción: la correlación entre caries de la infancia temprana y el consumo de azúcar en alimentos y bebidas no ha sido reportada en Colombia.

Objetivo: investigar la prevalencia de las caries en la infancia temprana y el consumo de azúcar en alimentos dentro de un jardín de educación preescolar.

Diseño: se realizó un estudio descriptivo con 124 niños con edades entre 3 y 4 años que asisten a tres entidades públicas de cuidado infantil entre semana. Se registraron sus hábitos alimenticios durante tres meses y se proyectaron hacia un año. Los niños fueron alimentados de acuerdo con un menú institucional que incluye el desayuno, el almuerzo y dos meriendas entre comidas y que se prepara siguiendo los lineamientos gubernamentales que miden las calorías y clasifican los alimentos por grupos. Luego de dejar la institución, la alimentación de los niños es responsabilidad de los padres y por esto, se les consultó, mediante un cuestionario, una entrevista y una visita domiciliaria, los hábitos alimenticios de los niños durante los fines de semana. La caries de la infancia temprana se investigó a través del sistema internacional de evaluación y detección de las caries.

Resultados: por año, se estimó que el consumo de azúcar de los niños es de 52.20 kg, lo que está por encima de la recomendación de la OMS. Incluso, aunque hay un aumento en el consumo de azúcar durante los fines de semana, la cantidad de azúcar entre semana también es importante, lo que se asocia con un incremento en el índice dmft. Asimismo, se asoció el tetero de la noche con la caries de la infancia temprana y se encontró que el cepillado para el control de la placa también es insuficiente.

Conclusión: el consumo excesivo de azúcar y el cepillado insuficiente son factores de riesgo importante para el desarrollo de caries de la infancia temprana en los niños colombianos. Colombia necesita promover e imple-

mentar políticas nutricionales más estrictas para reducir el consumo de azúcar de los niños y para mejorar el control de la placa dental en instituciones de cuidado y en casa para reducir la prevalencia de la caries en este momento del ciclo vital.

Palabras clave: riesgo de caries, consumo de azúcar; niños; caries de la primera infancia.

Resumo

Introdução: a correlação entre cárie na primeira infância e o consumo de açúcar em alimentos e bebidas não foi relatada na Colômbia.

Objetivo: investigar a prevalência de cárie na primeira infância e o consumo de açúcar em alimentos de uma horta pré-escolar.

Desenho: foi realizado um estudo descritivo com 124 crianças de 3 a 4 anos de idade que frequentam três instituições públicas de cuidados infantis durante a semana. Seus hábitos alimentares foram registrados por três meses e projetados para um ano. As crianças foram alimentadas de acordo com um cardápio institucional que inclui café da manhã, almoço e dois lanches entre as refeições, e preparado de acordo com as diretrizes do governo que medem calorias e classificam os alimentos por grupos. Após a saída da instituição, a alimentação das crianças é de responsabilidade dos pais e, por esse motivo, foram consultadas, por meio de questionário, entrevista e visita domiciliar, sobre os hábitos alimentares das crianças nos finais de semana. A cárie infantil foi investigada através do sistema internacional de detecção e avaliação de cáries.

Resultados: por ano, o consumo de açúcar infantil foi estimado em 52,20 kg, acima da recomendação da OMS. Embora exista um aumento no consumo de açúcar nos finais de semana, a quantidade de açúcar durante a semana também é importante, o que está associado a um aumento no índice dmft. Da mesma forma, a mamadeira noturna foi associada a cárie na primeira infância e a escovação para o controle da placa também foi considerada insuficiente.

Conclusão: consumo excessivo de açúcar e escovação insuficiente são fatores de risco importantes para o desenvolvimento de cárie na primeira infância em crianças colombianas. A Colômbia precisa promover e implementar políticas nutricionais mais rigorosas para reduzir o consumo de açúcar das crianças e melhorar o controle da placa dentária nas instituições de saúde e em casa para reduzir a prevalência de cárie neste momento do ciclo de vida.

Palavras-chave: Risco de cárie, ingestão de açúcar; Crianças; Cárie na primeira infância.

Introduction

Early childhood caries (ECC) affect children less than 71 months of age (1) and it represents a public health problem worldwide (2)-(4). The average ECC prevalence in United Nations Countries was 23.8% in children younger than 36 months and 57.3% in children aged 36 to 71 months, being East Asia, Latin America and the Caribbean areas the more affected by ECC (5) (6).

Dental caries pertains to a group of diseases that are estimated "complex" or "multifactorial," (7) and results from the interaction of bacteria, mainly *Streptococcus mutans* (SM) and *lactobacilli* (LB) species, and sugar intake that leads to acid production and dissolves enamel (7) (8). Lack of regular and efficient oral hygiene and absent of fluoride protection increases caries prevalence in most populations (9) (10).

Dietary sugar plays a crucial role in dental decay and is considered a main risk factor (11) (12). Frequent sugar intake increases in a linear dose-response caries risk, overweight and obesity (8)-(13). Specific dietary guidance for parents of young children, particularly, regarding frequency of intake of sugar-sweetened products, can effectively reduce ECC (14) (15). The WHO guideline recommends for adults and children to reduce their daily intake of free sugars to less than 10% of their total energy intake. A further reduction to below 5% or roughly 25 grams (6 teaspoons) per day would provide additional health benefits (16).

There is no reports on the association between ECC and sugar in foods and beverages in Colombian young children. Therefore, this study aims to describe the habits of sugar consumption of foods and drinks at three day-care centres and at home in pre-schoolers and their ECC prevalence in Cali.

Methods

A study was carried out on pre-school children from three-day care centres in the hillside area of Cali, to whom signed the informed consent signed by their parents and met the inclusion criteria. The Institutional Review Committee of Human Ethics, approved this project through Act 009-015.

Data were collected over a 3-month period (17) (18). One calibrated and trained dentist (Kappa intra-examiner 0.85 and inter-examiner 0.72), using artificial light, a mouth mirror, and a rounded tip explorer examined children. ICDAS criteria were used for detecting visual and tactile dental lesions and for describing their severity (19). ICDAS codes 2 to 6 were used to measure caries increments. ICDAS lesion 1, was excluded because is a difficult diagnosis. If a tooth presented two or more ICDAS diagnoses, the one with the highest degree of severity was recorded.

Children attended the day-care centres Monday to Friday from 7:30 am -16:00 pm. A menu determined the feeding of the children for breakfast, lunch and two between meals. Food-frequency questionnaires from previous dietary research (20) (21), adapted to the context of culture and dietary habits was used after field essay with some families. The questionnaire was given to the parents to evaluate the dietary habits of children at home during weekdays after 16:00 pm. and weekends. Questions included type of food, size of meal, frequency of eating and kind of drinking per day, snacks, candies and feeding before going to sleep. A home visit and an interview with the mother's during a weekend confirm the data reported, using an approach that summarizes the information captured by the food frequency variables and analysed

according to WHO, ORCA and EADPH guidelines (16) (22). Frequency of tooth brushing in the house and the day care was also recorded.

A system developed in the United States (23) and Mexico (24) classify beverages in soft-drink; fruit juice; chocolate milk; water of panela and milk/nutritional supplements. In Colombia a nutritional supplement based on a mixture of cereals, legumes and whole powder milk, that contains vitamins, minerals, essential fatty acids, amino-acids, and micronutrients is given to the children at day-care facilities on daily basis, with sugar intake (25).

Analyses were performed using SPSS 24 statistical software. For qualitative data, results were presented as frequency and percentage. Descriptive statistics were generated for the prevalence of caries, and the average dmft and dmft scores were also calculated. Comparison of questionnaire findings with oral health status was done using chi-square test and independent t-test and level of significance was fixed at $p < 0.05$.

Results

One hundred twenty-four children completed the study which includes dental examination, diet profile sugar consumption per day in grams and during 3 months period and this data was extrapolated to a whole year of sugar intake. Demographic and dmft index is presented in table 1. Boys slightly outnumbered girls. The combined dmft index was 2.95 (SD=4.27), and it was composed by 2.75 (SD=3.85) decayed, 0.10 (SD=0.39) missing, and 0.08 (SD=0.58) filled dentition. During toothbrushing, 65.4% of parents or guardians supervised the child and toothbrushing time was 30-45 seconds in average using mainly horizontal movements. Only five mothers reach university education, most reached primary and high school education and the majority were single mothers or divorced.

There were also several fluctuations in the average sugar consumption along the day and during the weekend. The higher sugar intake among the main meals was lunch with 42 grams during weekdays while sugar intake doubled up to 84 grams at home-dinner on weekdays. The daily consumption of sugar in the weekend increased by frequent eating of sweets, which corresponds to 236 grams per day. Child's sugar intake is increased at home by drinking 2-3 bottles sweetened with 12 grams of sugar each in 200 ml volume. Those bottles are given by the parents to the children at morning time, nap time, and right before sleep. Day-care institution did not allow the children to drink bottles at their location. The estimated sugar consumption by children per year was 52.20 kg or 194 grams of sugar at day (table 2).

Children's took a Colombian nutritional supplement 4.69 times per week usually at breakfast, mid-morning, and mid-afternoon snacks. Children who consumed more than 7 times per week this supplement increased their dmft up to 9.94 and other important factors increasing dmft values were backed goods, confection, chocolate milk and panela water intake as depicted in table 3.

The consumption fruit, was provided in whole fruit 6.27 times per week and as fruit juice 6.08 times per week that was sweetened with 25 g sugar in 1.5 l/volume and regular glass of juice contains up to 300 ml. Children consume the fruit juice more frequently than whole fruit. Juice accompanies lunch and sometimes mid-afternoon snack and dinner. Most commercial fruit juice lacks fiber.

Table 1. Demographics and dmft value in 124 Colombian Children and family context

Variable	Median +/- SD or %
Age	2.94 ± 4.27
Biological sex	
Male	64 (52%)
Female	60 (48%)
Weight (Kg)	17.24
Size (cm)	101.12
dmft* (SD)	2.95 (4.27)
Brushing	
Supervised	81 (65.4)
By themselves	43 (34.6)
Family context	
Not in a nuclear family	76 (61%)
In a nuclear family	48 (39%)
Mother's level of education	
University	5 (4%)
High school	62 (50%)
Primary school	57 (46%)
Mother's age	33.17 ± 2.82

*Decayed, Missing or Filled Surfaces

Source: Own elaboration.

Table 2. Average daily consumption of sugars in 124 preschool children and estimate per year.

Foods	Institution Monday-Friday (kg)	House Saturday-Sunday (kg)	Estimated average total (kg)
Breakfast	0,008	0,013	0,030
Mid morning snack	0,019	0,060	0,040
Lunch	0,042	0,039	0,040
Mid afternoon snack	0,017	0,040	0,030
Dinner*	0,038	0,084	0,054
Total	0,123	0,236	0,194
Extrapolated to the year	44,895	83,515	52,205

*Dinner at home.

Source: Own elaboration.

Table 3. Dietary exposures and caries severity (mean dmft)

	Food consumption Mean (SD)	Number of children (%)	Mean dmft (SD)
Snacks between meals (each day)	2.77 (0.42)		
Twice		28 (22.6)	0.5 (1.3)
Three		96 (77.4)	3.6 (4.5)
Drink feeding bottle before bed	1.31 (0.46)		
Yes		86 (69.4)	4.2 (4.5) *
No		38 (30.6)	0 (0) *
Drink feeding bottle (each day)	1.36 (1.12)		
0 times		38 (30.6)	0 (0) *
1-2 times		61 (49.2)	4.7 (4.8) *
>3 times		25 (20.2)	3.1 (3.6) *
Specific dietary exposures	<i>Per week</i>		
baked goods	1.36 (1.12)		
≤ 4 times per week		83 (66.9)	0.5 (0.8) *
5-6 times per week		31 (25)	5.7 (1.5) *
≥ 7 times per week		10 (8.1)	14.2 (3.7) *
Confectionery	5.27 (1.42)		
≤ 4 times per week		55 (44.4)	0.0 (0.1) *
5-6 times per week		33 (26.6)	2.6 (2.3) *
≥ 7 times per week		36 (29.1)	7.6 (4.7) *
Soft drink	1.73 (0.69)		
≤ 2 times per week		109 (87.9)	3.2 (4.3) *
≥ 3 times per week		15 (12.1)	1.0 (2.9) *

(continúa)

(viene)

	Food consumption Mean (SD)	Number of children (%)	Mean dmft (SD)
Fruit juice	6.08 (1,00)		
5-6 times per week		99 (79.8)	1.18 (1.6) [*]
≥ 7 times per week		25 (20.2)	2.5 (4.28) [*]
Fruit	6.27 (0.74)		
5-6 times per week		97 (78.3)	2.97 (4.25) [*]
≥ 7 times per week		27 (21.7)	2.85 (4.43) [*]
Chocolate milk	3.73 (1.28)		
≤ 4 times per week		92 (74.2)	0.89 (1.32) [*]
5-7 times per week		32 (25.8)	8.87 (4.30) [*]
Milk/ nutritional supplements	4.69 (1,10)		
≤ 4 times per week		83 (66.9)	0.55 (0.87) [*]
5-6 times per week		24 (19.4)	6.29 (3.61) [*]
≥ 7 times per week		17 (13.7)	9.94 (4.39) [*]
Panela Water	4.13 (1.51)		
< 4 times per week		106 (85.5)	1.9 (2.8) [*]
5-6 times per week		9 (7.3)	4.2 (0.8) [*]
≥ 7 times per week		9 (7.3)	13.5 (5.7) [*]

^{*} p < 0.001**Source:** Own elaboration.

Discussion

The intake of sugar–sucrose, is determined in kg/person/year. According to the current WHO guideline, sugar intake should be restricted to the amount providing less than 10% of the daily energy requirement, i.e., or below 20 kg of sugar/person/year. The focus is also directed to the fact that the energy restriction to below 5% provides additional health benefits (12) (26). High intake of added sugars is associated with excess energy and poor diet quality (27). Of interest, the reports that shown that below 15 kg/person/year most populations do not develop any dental caries. Between 15 and 35 kg intake per year there is a steeping increase in the rate of caries. Beyond 35 kg, the dose response curve flattens (12)–(15). In many western societies, the sugar availability is around or above 40 kg/person/year (13). Our study demonstrated an average of 52,20 kg/person/year in young children (table 2) which exceeds the average sugar consumption in even older people at European countries and Poland (27) (28). Africa and Asia have the lowest sugar consumption, averaging, respectively, 16.8 and 17.3 kg per person per year. America and Europe have the highest averaging

respectively 43.8 and 36.7 kg per capita. Sucrose consumption in developed countries is high and stable, whereas in developing countries (particularly in Asia, and, to a lesser extent, in the Middle-East and Africa), the intake of sugar is rapidly increasing after food chain industrialization (26).

In this study, sweets were consumed mainly during the weekend, and 29% of the child population consume confectionery seven times per week, and 12% consume soft drink more than three times a week (table 3). Marshall et al (29) associated the caries 3 to 4-year-olds with increased frequency of soft drink and high intake regular beverages. Most pre-schoolers consume sweets every day –on average 10 times per week–. These consumption patterns are a result of high availability and parental influence (such as their knowledge level, interest in, and habits regarding their children's nutrition) (30). The perception of parents that during the weekend, children should have more freedom for the consumption of sweets, bottle, and soft drink, is in accordance with previous research in this age group (31) (32). Therefore, providing parents with adequate oral and nutrition education appears to be a promising preventive measure to reduce sweets consumption rates among preschool children (33) (34).

In our study, the fruit juice contains a high amount of added sugar. Prolonged sugar exposure to dentition is a major contributing factor to dental caries. The vehicle in which the drink is given to children would make difference. For instance, juice should be offered to toddlers in cup and not in bottle, to decrease exposure of enamel to carbohydrates (35). By fortune, the day-care facilities offered the beverage to toddlers in cups. In contrast, children drank their beverages at home in bottle.

Consuming whole fruit rather than fruit juice, can help encourage parental support of healthy rates of weight gain in children (36). By fortune, the this childcare centres in Cali offer a mid-morning snack contain whole fruit (table 3). Fruit as snack follows the guidelines of healthy Food Guide Pyramid and represent a protective risk factor for ECC and along with good oral hygiene practices is highly encourage (37).

The Colombian drink "agua de panela" (i.e. panela water) is used as an energy source or as a heating body infusion in cold weather regions. In hot weather regions, panela water is also consumed as refreshing drink traditionally mixed with lemon or orange juice (38) (39). Panela water is essential in the regular diet among low social class children as many drink one bottle at night time just before sleeping from 1-3 years of age and, as shown in table 3, this factor increases dmft rates on a dose response manner. Weaning from the bottle should be encouraged after 12 to 14 months of age, otherwise ECC rates won't be reduced (37) (40).

These findings clearly show that sugar in food and drink consumption are indeed associated with caries experience as another study reveals (20). Baked goods,

panela water and Milk/ nutritional supplements seven or more times per week is associated with high dmft score (9.9-14.2), (table 3) score that was almost ten times higher than the dmft (0.5-1.9) score for children who snacked four or less times per week. Ruottinen et al (41) reported dmft of 1.4 of in high-sugars consumption group compared to 0.5 in a low-sugars consumption group.

It is essential that parents promote healthy eating and early toothbrushing which is associated with less caries experience in pre-schoolers (42). Children who started brushing later in life have higher dmft values than those who brush within the first year of age. A recent study also reveals that few children practiced toothbrushing twice per day, and 34.7% start toothbrushing after the age of 3, which is late to control ECC (43). In Colombia reports that 5-year-old children have bad plaque control as reveal the Simplified Oral Hygiene Index (44) and a association regarding access to oral healthcare for the parents' maximum educational level (45). Most parents in developing countries do not necessarily know that sugar intake leads to acidification of the mouth and decalcification of teeth and ECC. Therefore, oral health promotion and nutritional education is essential to be included at public health policies and programs.

Conclusion

This study reveals that sugar intake of children was 123 g per day during weekdays and increased up to 236 grams per day during weekends. Those result largely overpass the WHO-2015 guidelines of 52.5 grams per day. Night-time bottle feeding with panela water and frequent candy intake at home needs to be suppressed or significantly decreased in order to control ECC. A dose response association between sugar intake and high dmft index was confirmed here. We recommend urgent nutritional and oral care education program directed to parents and child day care institutions to reduce ECC prevalence in colombian children at population level.

References

1. American Academy on Pediatric Dentistry; American Academy of Pediatrics. Policy on Early Childhood Caries (ECC): Classifications, Consequences, and Preventive Strategies. *Pediatr Dent*. 2008; 30(7 Suppl): 40-43. <https://pubmed.ncbi.nlm.nih.gov/19216381/>
2. Ministerio de Salud y Seguridad Social. IV Encuesta de salud oral Nacional (ENSAB IV): situación de la salud oral. 2014.

3. Brasília M da S. Projeto SB Brasil 2010: Pesquisa Nacional de Saude Bucal-Resultados Principais (SB Brazil Project 2010: National Survey of Oral Health). 2011.
4. Bernabé E, Flaxman A, Naghavi M, Lopez A, Murray CJL. Global Burden of Oral Conditions in 1990-2010: A Systematic Analysis. *J Dent Res.* 2013; 92(7): 592-597. <https://doi.org/10.1177/0022034513490168>
5. Tantawi M El, Folayan MO, Mehaina M, Vukovic A, Castillo JL, Gaffar BO, et al. Prevalence and Data Availability of Early Childhood Caries in 193 United Nations Countries, 2007 – 2017. *Am J Public Heal.* 2018; 108(8): 1066-1072. <https://doi.org/10.2105/AJPH.2018.304466>
6. Ramos-Sanes D, Martínez-Zapata LN, Chica-Corrales E, Ortiz-Camargo YP, Díaz-Garavito MV. Prevalencia de caries de los escolares de La Institución Educativa Rural filo de Damaquiel, municipio de San Juan de Urabá-Antioquia, 2014. *Rev Nac Odontol.* 2016; 12(23): 49-56. <https://doi.org/10.16925/od.v12i23.1380>
7. Philip N, Suneja B, Walsh LJ. Ecological Approaches to Dental Caries Prevention: Paradigm Shift or Shibboleth? *Caries Res.* 2018; 52(1-2): 153-165. <https://doi.org/10.1159/000484985>
8. Breda J, Keller A. The Importance of the World Health Organization Sugar Guidelines for Dental Health and Obesity Prevention. *Caries Res.* 2019; 53: 149-152. <https://doi.org/10.1159/000491556>
9. WHO, FDI, IADR CSA. The Beijing declaration: call to action to promote oral health by using fluoride in China and Southeast Asia; 2007. Available in: <https://www.fdiworldddental.org/oral-health/fluoride/conferences>
10. Gómez Osorno AM, Bernal Álvarez T, Posada López A, Agudelo Suárez AA. Caries dental, higiene bucal y necesidades de tratamiento en población de 3 a 5 años de una institución educativa de Medellín y sus factores relacionados. *Rev Nac Odontol.* 2015; 11(21): 23-35. <https://doi.org/10.16925/od.v11i21.933>
11. Çolak H, Dülgergil ÇT, Dalli M, Hamidi MM. Early Childhood Caries Update: A Review of Causes, Diagnoses, and Treatments. *J Nat Sci Biol Med.* 2013; 4(1): 29-38. <https://doi.org/10.4103/0976-9668.107257>
12. Moynihan P. Sugars and Dental Caries: Evidence for Setting a Recommended Threshold for Intake 1 – 3. *Adv Nutr.* 2016; 7(1): 149-156. DOI: 10.3945/an.115.009365

13. Van Loveren C. Sugar Restriction for Caries Prevention: Amount and Frequency. Which Is More Important? *Caries Res.* 2018;53:168–75. <https://doi.org/10.1159/000489571>
14. Sheiham A, James WPT. A New Understanding of the Relationship between Sugars, Dental Caries and Fluoride Use: implications for limits on sugars consumption. *Public Health Nutr.* 2014; 17(10): 2176-2184. <https://doi.org/10.1017/S136898001400113X>
15. Bermudez OI, Cohen SA, Must A. Dietary Intake and Severe Early Childhood Caries in Low-Income, Young Children. *J Acad Nutr Diet.* 2013; 113(8): 1057-1061. <https://doi.org/10.1016/j.jand.2013.03.014>
16. World Health Organization. Guideline: Sugars Intake for Adults and Children. 2015.
17. Villavicencio J, Arango MC, Ordonez A, Contreras A, Villegas LM. Early Childhood Caries, Salivary and Microbiological Aspects Among 3- to 4-year-old Children in Cali, Colombia. *Eur Arch Paediatr Dent.* 2018; 19(5): 347-352. <https://doi.org/10.1007/s40368-018-0365-5>
18. Villavicencio J, Villegas LM, Arango MC, Arias S. Effects of a Food Enriched with Probiotics on *Streptococcus mutans* and *Lactobacillus* spp . Salivary Counts in Preschool Children: a Cluster Randomized Trial. *J Appl oral Sci.* 2018; 26(e20170318): 1-9. <http://orcid.org/0000-0003-4390-589X>
19. Pitts NB, Ekstrand K. International Caries Detection and Assessment System (ICDAS) and Its International Caries Classification and Management System (ICCMS) - Methods for Staging of the Caries Process and Enabling Dentists to Manage Caries. *Community Dent Oral Epidemiol.* 2013;41(1):e41–e52. <https://doi.org/10.1111/cdoe.12025>
20. Hashim R, Williams SM, Murray Thomson W. Diet and Caries Experience Among Preschool Children in Ajman, United Arab Emirates. *Eur J Oral Sci.* 2009; 117(6): 734-740. <https://doi.org/10.1111/j.1600-0722.2009.00688.x>
21. Nelson MC, Lytle LA. Development and Evaluation of a Brief Screener to Estimate Fast Food and Beverage Consumption Among Adolescents. *J Am Diet Assoc.* 2019; 109(4): 730-734. <https://doi.org/10.1016/j.jada.2008.12.027>
22. Schulte AG, Tsakos G. The Joint ORCA-EADPH Symposium on Sugar: The Oral Health Perspective—A Commentary. *Caries Res.* 2019; 145-148. <https://doi.org/10.1159/000490951>

23. Popkin BM, Armstrong LE, Bray GM, Caballero B, Frei B, Willett WC. A New Proposed Guidance System for Beverage Consumption in the United States. *Am J Clin Nutr.* 2006;83:529–542. <https://doi.org/10.1093/ajcn.83.3.529>
24. Stern D, Piernas C, Barquera S, Rivera JA, Popkin BM. Caloric Beverages Were Major Sources of Energy among Children and Adults in Mexico, 1999–2012. *J Nutr.* 2014; 144: 949-956. <https://doi.org/10.3945/jn.114.190652>
25. Instituto Colombiano de Bienestar Familiar. República de Colombia Departamento para la Prosperidad Social (DPS). *Nutrición.* 2018.: <https://www.icbf.gov.co/bienestar/nutricion>
26. Moynihan P, Makino Y, Petersen PE, Ogawa H. Implications of WHO Guideline on Sugars for dental health professionals. *Community Dent Oral Epidemiol.* 2018; 46(1): 1-7. <https://doi.org/10.1111/cdoe.12353>
27. Bailey RL, Fulgoni VL, Cowan AE, Gaine PC. Sources of Added Sugars in Young Children, Adolescents, and Adults with Low and High Intakes of Added Sugars. *Nutrients.* 2018; 10(102): 1-11. <https://doi.org/10.3390/nu10010102>
28. Olczak-Kowalczyk D, Turska A, Gozdowski D, Kaczmarek U. Dental Caries Level and Sugar Consumption in 12-Year-Old Children from Poland. *Adv Clin Exp Med.* 2016; 25(3): 545-550. <https://doi.org/10.17219/acem/61615>
29. Marshall TA, Levy SM, Broffitt B, Warren JJ, Eichenberger-Gilmore JM, Burns TL, et al. Dental Caries and Beverage Consumption in Young Children. *Pediatrics.* 2003; 112(3): e184-91. <https://doi.org/10.1542/peds.112.3.e184>
30. Schneider S, Jerusalem M, Mente J, De Bock F. Sweets Consumption of Preschool Children—Extent, Context, and Consumption Patterns. *Clin Oral Investig.* 2013 Jun 7; 17(5): 1301-1309. <https://doi.org/10.1007/s00784-012-0813-2>
31. Hoffmann D, Marx J, Burmeister J, Musher-Eizenman D. Friday Night Is Pizza Night: A Comparison of Children’s Dietary Intake and Maternal Perceptions and Feeding Goals on Weekdays and Weekends. *Int J Environ Res Public Health.* 2018 Apr 11; 15(4): 720. <https://doi.org/10.3390/ijerph15040720>
32. Essman M, Popkin BM, Corval C, Reyes M, Taillie LS. Sugar-Sweetened Beverage Intake among Chilean Preschoolers and Adolescents in 2016: A Cross-Sectional Analysis. *Nutrients.* 2018; 10(1767): 1-15. <https://doi.org/10.3390/nu10111767>

33. Plutzer K, Spencer AJ, Keirse MJNC. Reassessment at 6–7 Years of Age of a Randomized Controlled Trial Initiated Before Birth to Prevent Early Childhood Caries. *Community Dent Oral Epidemiol.* 2012; 40(6): 116-124. <https://doi.org/10.1111/j.1600-0528.2011.00643.x>
34. Mohebbi SZ, Virtanen JI, Vehkalahti MM. A Community-Randomized Controlled Trial Against Sugary Snacking Among Infants And Toddlers. *Community Dent Oral Epidemiol.* 2012 Feb; 40(Suppl. 1): 43-48. <https://doi.org/10.1111/j.1600-0528.2011.00665.x>
35. Heyman MB, Abrams SA. Fruit Juice in Infants, Children, and Adolescents: Current Recommendations. *Pediatrics.* 2017; 139(6): e20170967. <https://doi.org/10.1542/peds.2017-0967>
36. Bolling C, Crosby L, Boles R, Stark L. How Pediatricians Can Improve Diet and Activity for Overweight Preschoolers: A Qualitative Study of Parental Attitudes. *Acad Pediatr.* 2009; 9(3): 172-178. <https://doi.org/10.1016/j.acap.2009.01.010>
37. Naidoo S, Myburgh N. Nutrition, oral Health and the Young Child. *Matern Child Nutr.* 2007; 3(4): 312-321. <https://doi.org/10.1111/j.1740-8709.2007.00115.x>
38. García JM, Narváez PC, Heredia FJ, Orjuela Á, Osorio C. Physicochemical and sensory (aroma and colour) characterisation of a non-centrifugal cane sugar (“panela”) beverage. *J Food Chem.* 2017; 228: 7-13. <https://doi.org/10.1016/j.foodchem.2017.01.134>
39. Jaffé WR. Nutritional and Functional Components of Non Centrifugal Cane Sugar: A Compilation of the Data from the Analytical Literature. *J Food Compos Anal.* 2015;43:194-202. <https://doi.org/10.1016/j.jfca.2015.06.007>
40. Avila WM, Pordeus IA, Paiva SM, Martins CC. Breast and Bottle Feeding as Risk Factors for Dental Caries: A Systematic Review and Meta-Analysis. Clifford T, editor. *PLoS One.* 2015 Nov 18; 10(11): e0142922. <https://doi.org/10.1371/journal.pone.0142922>
41. Ruottinen S, Karjalainen S, Pienihäkkinen K, Lagström H, Niinikoski H, Salminen M, et al. Sucrose Intake since Infancy and Dental Health in 10-Year-Old Children. *Caries Res.* 2004; 38(2): 142-148. <https://doi.org/10.1159/000075938>
42. Chen KJ, Gao SS. Managing Early Childhood Caries for Young Children in China. *Healthcare.* 2018 Jan 30; 6(1): 11. <https://doi.org/10.3390/healthcare6010011>
43. Sun X, Bernabé E, Liu X, Gallagher JE, Zheng S. Early Life Factors and Dental Caries in 5-Year-Old Children in China. *J Dent.* 2017; 64: 73-79. <https://doi.org/10.1016/j.jdent.2017.06.007>

44. Ospina D, Herrera Y, Betancur J, Agudelo HB, Posada-López A. Higiene bucal en la población de San Francisco Antioquia y sus factores relacionados. *Rev Nac Odontol*. 2016 Jan 15; 12(22): 23-30. <https://doi.org/10.16925/od.v12i22.1203>
45. Martignon S, Usuga-Vacca M, Cortés F, et al. Risk factors for early childhood caries experience expressed by ICDAS criteria in Anapoima, Colombia: a cross-sectional study. *Acta Odontol Latinoam*. 2018;31(1):58-66.