Received: 12 January 2021 | Revised: 13 April 2021 | Accepted: 30 April 2021
DOI: 10.1111/joss.12666

REVIEW

Journal of Sensory Studies
WILEY

Sugar reduction in products targeted at children: Why are we not there yet?

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Funding information
Foundation for Research Levy on Agricultural Products, Grant/Award Number: "FoodForFuture" (2021-2024); H2020 Marie Skłodowska-Curie Actions, Grant/Award Number: 764985

Abstract

Sugar intake among children has raised concern worldwide as it exceeds nutritional recommendations. Sugar contributes to the daily energy intake, without providing additional nutritional value and is associated with several negative health outcomes. Sugars added to foods during industrial processing have been identified as the main source of sugar in children's diets. The present work critically discusses the role of the food industry in contributing to children's excessive sugar intake worldwide, and the strategies that have been encouraged or implemented to reduce the sugar content in products targeted at children. The risk of the current sugar reduction practices in products targeted at children is discussed based on recent scientific evidence. Children's heightened preference for sweetness may not justify the availability of highly sugary products for children. Although research suggests that children readily accept less sweet products, there is still some wariness in the food industry to reduce sweetness intensity. This has strengthened the use of non-nutritive sweeteners (NNS), focusing on maintaining the sweetness level. However, emerging evidence suggests that this may not be the best approach.

Practical applications

Research shows that significant sugar reduction is feasible in products targeted at children without affecting hedonic perception, even if sweetness is reduced. The scientific evidence discussed in the present work challenges traditional approaches to sugar reduction and gives real life, practical recommendations for practitioners. All stakeholders (industry, food and health researchers, and policy makers) involved in the reformulation of products targeted at children are encouraged to prioritize children's best interest and protect their right to a healthy diet.

1 | INTRODUCTION

Childhood overweight and obesity is one of the most important public health problems worldwide, affecting 5.9% of children under 5 and 18.4% of 5–19 year old children (UNICEF, 2019). Overweight and obesity during childhood has negative short-term and long-term effects on health and wellbeing, including increased risk for cardiovascular diseases, type 2 diabetes, and cancer, as well as increased likelihood of suffering depression and other psychological disorders (Sutaria, Devakumar, Yasuda, Das, & Saxena, 2019; Weihrauch-Blüher, Schwarz, & Klusmann, 2019). The magnitude of the adverse consequences of childhood overweight and obesity will only become fully visible in several years (Ludwig, 2007). Despite global concern, no country has been successful yet in reducing the prevalence of childhood overweight and obesity in the last 20 years (Garrido-Miguel et al., 2019; UNICEF, WHO, & The World Bank, 2020). This stresses the need to urgently develop effective multifaceted approaches to curb the pandemic.

The global childhood obesity pandemic is the result of the complex interaction of socioeconomic, cultural, and demographic changes that have created an obesogenic environment that promotes unhealthy diets and a sedentary lifestyle (Meldrum, Morris, & Gambone, 2017). Children's diets are far from optimal, being characterized by a low consumption of fruits and vegetables and an excess of products high in sugar, saturated fat and sodium (UNICEF, 2019). In particular, sugar intake among children has raised concern worldwide as it exceeds recommendations (Perrar, Schmitting, Della Corte, Buyken, & Alexy, 2020; Powell, Smith-Taillie, & Popkin, 2016; Wittekind & Walton, 2014).

The World Health Organization recommends that adults and children should limit their daily intake of free sugars to less than 10% of their total energy intake and emphasizes that a reduction below 5% would provide additional health benefits (World Health Organization, 2015). However, despite differences in the estimation of dietary sugars among countries (Wittekind & Walton, 2014), published data shows that this recommendation is not met in most countries (Afeiche, Koyratty, Wang, Jacquier, & Lê, 2018; Cediel et al., 2018; Farro, Montero, Vergara, & Ríos-Castillo, 2018; Powell et al., 2016). For example, added sugar accounted for 16% of total energy intake of 6–11 years old children in the United States (Powell et al., 2016) and for 12% of the total energy intake of 4–13 years Mexican children (Afeiche et al., 2018), whereas in European countries the intake of added sugars varies between 11 and 17% of the total dietary energy intake (Wittekind & Walton, 2014). Sugar contributes to the daily energy intake, without providing additional nutritional value. In addition, sugar intake has been associated with numerous negative health outcomes (Paglia, Friuli, Colombo, & Paglia, 2019), including increased cardiovascular risk factors such as adiposity and dyslipidemia (Vos et al., 2017), dental caries (Chi & Scott, 2019), and metabolic syndrome (Wang et al., 2013). Overconsumption of sugar may represent a threat to children's mental health as it has been linked to changes in neural systems, altered emotional processing, anxiety and depression (Jacques et al., 2019).

Although sugars are naturally present in foods (e.g., fruits, vegetables, milk and honey), sugars added to foods during industrial processing have been identified as the main source of sugar in children's diets (Afeiche et al., 2018; Powell et al., 2016; Rauber et al., 2019). In particular, sweetened beverages, sweet bakery products, confectionary and dairy products have been identified as the main contributors to children's sugar intake in European countries (Azaïs-Braesco, Sluik, Maillot, Kok, & Moreno, 2017), the United States (Bailey, Fulgoni, Cowan, & Gaine, 2018; Herrick, Fryar, Hamner, Park, & Ogden, 2020), Australia (Lei, Rangan, Flood, & Louie, 2016) and Latin American countries (Popkin & Reardon, 2018).

In this commentary, we aim to critically discuss the role of the food industry in contributing to children's excessive sugar intake worldwide and the strategies that have so far been encouraged or implemented to revert this situation. We raise awareness of the risk of following current practices to reduce sugar in products targeted at children in the light of emerging scientific evidence and call for the need to tackle this complex challenge from a new perspective, based on children's rights.

2 | FOODS TARGETED AT CHILDREN: WHY DO THEY HAVE SO MUCH SUGAR?

Children's heightened preference for sweetness is universal across cultures (Mennella & Bobowski, 2015). Children have been reported to prefer higher sweetness intensities compared to adults, which has been explained by their high energy requirements in a period of rapid growth (Drewnowski, 2000; Liem & Mennella, 2002). This explanation is supported by the association between sweetness preference and growth markers. Coldwell, Oswald, and Reed (2009) reported that adolescents with high sweetness preference showed higher levels of a growth marker in urine (bone resorption marker type I collagen cross-linked N-telopeptides) and plasma leptin than adolescents with low sweetness preference.

Modern societies have normalized children's consumption of sugary products as a consequence of their preference for sweet taste. Since the 19th century, sugary products started to be positioned as a treat for children, who many times are encouraged to learn the value of money by selecting and purchasing candies (Woloson, 2002). Already decades ago, the food industry identified a market niche and started manufacturing a wide range of products containing high concentrations of sugar, an inexpensive ingredient, and marketing them as fun and appropriate for children (Elliott, 2015; Moss, 2013). The global market of child-oriented food and beverages is posed to reach 146.7 billion US dollars by the year 2025, with an annual growth rate of 5% (ReportLinker, 2020).

A recent review by Elliott and Truman (2020) showed that the vast majority of the products targeted at children available in the market cannot be regarded as suitable for them due to their high energy density and added sugar and fat. Sugar has been reported to be the most common nutrient exceeding nutritional recommendations among products targeted at children. According to Giménez, Saldamando, Curutchet, and Ares (2017) 92% of the products targeted at children commercialized in the Uruguayan marketplace contained an excessive amount of free sugars according to the nutrient profile model of the Pan American Health Organization. Similarly, Elliott (2019) reported that 77% of the child-targeted products in Canadian supermarkets were high in sugar.

Nowadays, products with high sugar content targeted at children can be found across a wide range of food categories, including confectionary, cookies, dairy products, cereals and sweetened beverages (Elliott & Truman, 2020). Products are targeted at children through packaging and are also frequently formulated specifically for them; the problem is that such products are not actually healthier. Products targeted at children have been reported to have higher sugar content than those targeted at the non-children population (Moore, Sutton, &

Hancock, 2020; Rito et al., 2019). However, children's heightened sweetness preference does not fully justify the sugar content of commercial products targeted at them. Velázquez, Vidal, Varela, and Ares (2020) reduced 40% the sugar content of vanilla milk desserts respect to commercial products targeted at children available in the Uruguayan marketplace. They reported that, despite some changes in the sensory profile, school-aged children liked the sugar-reduced products as much as they liked the regular product. Moreover, they found that a proportion of children disliked the samples with the highest sugar content. Similarly, Lima, Ares, and Deliza (2019) showed that the added sugar content of grape nectars could be reduced 21.6% without affecting children's liking. These results suggest that the general belief that children may prefer excessively sweet products may not be completely true as they may regard the products available in the market as too sweet. Similar results have been recently reported among adults by Reed, Mainland, and Arayata (2019). According to these authors, who analyzed consumers' reviews of commercial products sold on-line, consumers are more likely to perceive commercial products excessively sweet rather than with a lack of sweetness.

3 | DIRECT SUGAR REDUCTION: A FEASIBLE BUT FEARED STRATEGY

The major contribution of processed products to children's sugar intake suggests that product reformulation is one of the cost-effective strategies that can be implemented to reduce sugar intake at the population level (MacGregor & Hashem, 2014). Recent studies have shown that reformulation of products targeted at children may be a feasible way to reduce children's sugar intake and to improve the nutritional quality of their diets, even if they continue eating the same products (Hashem, He, & MacGregor, 2019; Muth, Karns, Mancino, & Todd, 2019; Yeung et al., 2017).

Although several countries have implemented voluntary sugar reduction programs (Belc, Smeu, Macri, Vallauri, & Flynn, 2019; Breda et al., 2020), progress in reducing sugar across the food assortment has been slow. For example, in 2015 the UK implemented a sugar reduction program which aims to gradually decrease 20% of the sugar content by 2020 in food products regarded as important contributors to children's sugar intake (Public Health England, 2017). According to the latest progress report, the target will be unlikely accomplished as the overall reduction achieved between 2015 and 2019 was only 3% (Public Health England, 2020). The highest reductions in sugar content were achieved for yogurts and breakfast cereals, reaching 13% (Moore et al., 2020; Public Health England, 2020).

The low cost and versatility of sugar, as well as concerns over the consumer rejection of sugar-reduced products are some of the factors underlying the modest achievements of voluntary sugar reduction programs (World Health Organization, 2017). One of the main concerns of the food industry regarding sugar reduction is that consumers may find the reformulated product unacceptable, putting at risk the company competitiveness and profit (World Health Organization, 2017). Children's heightened preference for sweetness (Mennella, Finkbeiner, & Reed, 2012) and the key role that pleasure plays in their food choices (Nicklaus, Boggio, Chabanet, & Issanchou, 2004; Nicklaus & Remy, 2013) may reinforce this idea in the case of products targeted at children. However, this concerns is not fully justified by experimental evidence.

Several studies have reported that 5–10 years old children have lower sweet taste sensitivity compared to adults, suggesting that they may be less capable of perceiving differences in the sugar content of products (Glanville, Kaplan, & Fischer, 1964; James, Laing, & Oram, 1997; Yasaki, 1976). In addition, recent studies have shown that sugar reduced products may still be liked by children. The feasibility of direct sugar reduction with minor effects on children's hedonic perception has been documented in sweetened beverages and dairy products (Li, Lopetcharat, Qiu, & Drake, 2015; Lima et al., 2019; Velázquez, Vidal, Varela, & Ares, 2020). Recently, Velázquez, Vidal, Alcaire, Varela, and Ares (2020) showed that a sugar reduction up to 25% was possible in chocolate milk, vanilla yogurt, and vanilla milk desserts without significant changes on the liking of 8–13 years old children. However, there is still a need to explore the impact of direct sugar reduction in a wider range of product categories. So far, most of the studies exploring the impact of direct sugar reduction have focused on beverages and semi-solid foods and few information is available regarding their application in solid matrices (e.g., bakery products), where sugar seems to play a role beyond sweet taste (Sahin, Zannini, Coffey, & Arendt, 2019; Struck, Jaros, Brennan, & Rohm, 2014).

Despite reductions of up to approximately 20% seem feasible without affecting children's hedonic perception, gradual and progressive reductions may contribute to minimize any potential negative reactions toward sugar reduction. The rationale behind this approach is that sugar content of the product is reduced in such a way that consumers slowly get used to products with lower sugar content, without noticing the changes (Macgregor & Hashem, 2014). Lima et al. (2019) studied the impact of direct sugar reduction in grape nectars on children's hedonic perception by comparing a gradual strategy versus a stepwise strategy over 9 weeks. They found that the gradual sugar reduction strategy produced smaller changes in children's hedonic perception compared to the stepwise strategy. Further research is needed to confirm that these results can be escalated and reproduced in the long term (Hutchings, Low, & Keast, 2019). Nevertheless, it should be noted that a gradual salt reduction program in the UK achieved a reduction of 15% in salt intake at the population level over a 7 years' time span (Macgregor & Hashem, 2014). This successful implementation suggests that gradual reduction of critical nutrients has a high potential in a large-scale level.

Gradual sugar reduction intends to shift children's sweetness preference rather than maintaining current behavior, which may have a long lasting impact on dietary patterns and health outcomes (Ma, He, Yin, Hashem, & MacGregor, 2016). This is particularly relevant in the case of children, given that during this period of life they acquire long-lasting preferences (Mennella & Bobowski, 2015). Through exposure and associative learning children learn what foods should taste sweet and how sweet they should be (Forestell & Mennella, 2007; Rozin, 1984; Sullivan & Birch, 1990).

4 | A CALL FOR REDUCING SUGAR AND SWEETNESS INTENSITY IN PRODUCTS TARGETED AT CHILDREN

Sugar reduction has long been positioned as the impossible dream: reducing sugar without modifying the sensory characteristics of products (Hutchings et al., 2019). Considering that sweetness is the most important contribution of sugar in food products, sugar reduction efforts have been mainly focused on maintaining the sweetness level of the products (Di Monaco, Miele, Cabisidan, & Cavella, 2018; Hutchings et al., 2019; McCain, Kaliappan, & Drake, 2018; Sahin et al., 2019). This strategy does not only contribute to a reaffirmation of children's preference for highly sweet products (Liem & de Graaf, 2004), it may also hinder the potential of alternatives that target at modifying children's preferences by reducing the exposure to sweet taste.

Children shape their preferences through experience (Sullivan & Birch, 1990). Although humans have an innate preference for sweetness, preference for products with high sugar content is also learned over repeated experiences (Liem & de Graaf, 2004; Marty, Chambaron, Nicklaus, & Monnery-Patris, 2018). In a longitudinal study with 4–6 years old children, Vennerød, Nicklaus, Lien, and Almli (2018) showed that sweet preferences increase with age. Furthermore, exposure to high sweet food has been associated with higher preference for sweetness (Vennerød, Almli, Berget, & Lien, 2017). In this sense, maintaining sweetness may reaffirm and promote children's preference for highly sweet products of poor nutrient content. This not only adversely impacts children's current dietary patterns but also their preferences as adults (Nicklaus et al., 2004; Nicklaus & Remy, 2013).

Emerging evidence on the metabolic role of sweetness, further stresses the need to reduce both sugar content and sweetness intensity. The physiological role of sweetness has been traditionally associated with its ability to generate reward to promote the ingestion of foods containing sugar (Saper, Chou, & Elmquist, 2002). However, the activation of the sweet receptors in the mouth may act as a cue for sugar arriving to the gut, triggering a series of anticipatory automatic physiological responses related to the metabolism of carbohydrates (Burke & Small, 2015; Veldhuizen et al., 2017). In addition, the body has sweet taste receptors in extra-oral tissues, whose activation also triggers the secretion of hormones that exert multiple physiological effects, including the regulation of insulin secretion (Han, Bagenna, & Fu, 2019). This suggests that reduction of sugar while maintaining sweetness intensity may have metabolic consequences in the body.

When products are sweetened with non-nutritive sweeteners (NNS), the body receives the signal corresponding to sweet taste, uncoupled from energy load and its associated physiological responses. A growing body of evidence suggests that uncoupling sweetness from energy load could interfere with the learned relationships between sweet taste and the regulation of glucose metabolism, leading to the development of glucose intolerance (Burke & Small, 2015; Han et al., 2019; Veldhuizen et al., 2017). This effect may be of utmost importance in the case of children, who are still learning the relationship between sweetness intensity and energy. According to a recent study this effect may be particularly relevant when NNS are consumed together with carbohydrates, for example, cookies or fruit juice sweetened with NNS. Dalenberg et al. (2020) showed that consuming sucralose in the presence of carbohydrates decreases insulin sensitivity and brain responses to sweet taste. Although further research in this area is needed, concerns should be raised about exposing children to products sweetened with NNS.

5 | THE POTENTIAL NEGATIVE CONSEQUENCES OF REPLACING SUGAR BY NON-NUTRITIVE SWEETENERS IN PRODUCTS TARGETED AT CHILDREN

The use of NNS has become the default option for reducing the sugar content of foods and beverages (Di Monaco et al., 2018; Hutchings et al., 2019; McCain et al., 2018; Sahin et al., 2019). Since NNS have a higher sweetening power, significant sugar reductions are possible with minor effects on sweet taste (Edwards, Rossi, Corpe, Butterworth, & Ellis, 2016). Although NNS usually have bitter and metallic aftertaste which may negatively impact children's acceptance (Li et al., 2015; Li, Lopetcharat, & Drake, 2014), their consumption has largely increased. Sylvetsky, Welsh, Brown, and Vos (2012) showed that the number of children consuming products with NNSs has almost doubled from 1999–2000 to 2007–2008 in the United States. Although worldwide children's intake of the main NNS appears to be within international recommendations, this age group seems to be particularly vulnerable to exceed acceptable daily intakes (Martyn et al., 2018). In addition, it should be highlighted that consumption of NNS among children is expected to increase, as sugar reduction programs continue to prioritize partial or total substitution of sugar while maintaining sweetness. According to a recent study conducted in Chile, 55.5% of the processed products contain at least one sweetener as a consequence of the response of the food industry to the implementation of nutritional warnings highlighting products with high sugar content (Sambra et al., 2020). After enforcement of the Chilean regulation, Martínez et al. (2020) evaluated consumption of NNS among 250 school-aged children (6–12 years old). They reported that all children consumed at least one NNS during the month prior to the study, mainly as ingredients in beverages, dairy products and desserts. Sucralose was the most frequently consumed NNS, followed by acesulfame-K and stevia. However, consumption of none of the NNS exceeded acceptable daily intakes.

Although several recent documents stress the safety of NNS (Ashwell et al., 2020), consensus has not been reached yet (Toews, Lohner, de Gaudry, Sommer, & Meerpohl, 2019). Concerns over the methodological and reporting quality of studies conducted with humans (Toews et al., 2019) and the potential influence of conflicts of interest on recommendations regarding NNS (Mandrioli, Kearns, & Bero, 2016) stress the need to conduct further independent research on the topic. This is particularly relevant in the case of children, as research focused on this population is still scarce and contradictory (Brown, De Banate, & Rother, 2010).

However, emerging evidence justifies increasing concerns about the potential negative effects of NNS on children's health (Swithers, 2015). A recent systematic meta-analysis has shown that consumption of NNS during childhood and adolescence is associated with a significant increase in body mass index, with an odd-ratio of 1.15 (Karalexi, Mitrogiorgou, Georgantzi, Papaevangelou, & Fessatou, 2018). Similarly, exposure to NNS during pregnancy has been also linked with increased body mass index in the offspring (Azad et al., 2016). Moreover, increasing concerns have been raised over the bacteriostatic properties of NNS and their potential negative impact on the gastro-intestinal environment (Suez et al., 2014). Although results from animal studies have shown that NNS alter the gut microbiota, evidence from studies involving humans are still inconclusive (Khan, Ayoub-Charette, Sievenpiper, & Comelli, 2020). Therefore, current evidence is not enough to fully disregard potential negative effects of NNS on children's health.

6 | THE NEED FOR A CHILD RIGHTS-BASED APPROACH TO REDUCING SUGAR IN PRODUCTS TARGETED AT CHILDREN

Although it may seem harmless, manufacture and marketing of products targeted at children with excessive content of sugar can be regarded as a breach to some of the principles of the convention of the rights of the child. According to Article 3, the best interests of the child should be taken into consideration in all actions concerning children (UNICEF, 1989), which includes marketing of unhealthy products as appropriate for them (UNICEF, 1989). In addition, Article 24 recognizes children's right to health, which can be interpreted as "*an inclusive right, extending not only to timely and appropriate prevention, health promotion, curative, rehabilitative and palliative services, but also to a right to grow and develop to their full potential and live in conditions that enable them to attain the highest standard of health through the implementation of programs that address the underlying determinant of health*" (Committee on the Rights of the Child, 2013). This suggests that governments should implement appropriate actions to guarantee that children grow and develop in an environment that enables them to achieve their full potential, addressing the underlying determinants of health. In this sense, policies targeted at reducing the availability of products targeted at children with high sugar content are needed.

International experience suggests that relying on the commitment of the food industry to reduce the sugar content of products targeted at children will not be enough (Hashem et al., 2019). Governmental action seems necessary to achieve a substantial sugar reduction. For this purpose, responsive regulatory approaches that progress from voluntary reformulation programs to mandatory if the expected results are not achieved have been recommended (Reeve & Magnusson, 2015).

Article 12 of the Convention states that children have the right to express their views, particularly in matters related to their health and wellbeing (UNICEF, 1989). This suggests that children and adolescents should be provided with the opportunity to be part of the development of more effective strategies to reduce sugar intake, as previously stressed in the context of health promotion (Spencer, 2014). Co-creation of low-sugar products with children and adolescents is an interesting avenue for further research, which may contribute to the development of more innovative healthy products, accepted by the target population (Voorberg, Bekkers, & Tummers, 2015).

In addition, it should be highlighted that this isolated policy is unlikely to be enough to tackle the problems associated to a high consumption of added sugar (Bes-Rastrollo, Sayon-Orea, Ruiz-Canela, & Martinez-Gonzalez, 2016). Instead, a multicomponent sugar reduction strategy seems necessary to reduce sugar consumption and lessen their associated health and economic costs (Amies-Cull, Briggs, & Scarborough, 2019; Huang et al., 2019; Vyth et al., 2012; Yeung et al., 2017). For instance, taxation of food and beverages with added sugar, restriction of availability of poor nutrient quality products in schools, restrictions of marketing strategies targeted at children, front-of package labeling and reformulation of food products have been encouraged by international public health organizations (Popkin & Hawkes, 2016). These policies are expected to have a synergetic effect, contributing to more effectively achieve the objectives they seek.

7 | CONCLUSIONS

Although the need for reducing sugar intake among children has been widely acknowledged, progress in reducing the sugar content of products targeted at children has been slow and insufficient. In the present work, we advocate for a change in how products targeted at children are conceptualized, highlighting the need to adopt a child-rights view. Food scientists should take into account the best interests of children when engaging in the development of products targeted at them, avoiding high content of sugar, as well as the use of any ingredient with potential negative effects on their health and wellbeing. In this sense, emerging evidence stresses the need to avoid the use of non-nutritive sweeteners as part of the efforts to reduce the sugar content of products targeted at children, as well as of any other product frequently consumed by them. We encourage food scientists to promote a new approach to sugar reduction by putting aside the premise of avoiding changes in the sensory characteristics of products and focusing on reducing both sugar content and sweetness intensity.

ACKNOWLEDGMENTS

This work is part of the project "Edulia—Bringing down barriers to children's healthy eating," which has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No. 764985.

Funding was also received from Espacio Interdisciplinario (Universidad de la República, Uruguay). Author P. Varela also received financial support from the Norwegian Foundation for Research Levy on Agricultural Products FFL, through the research program "FoodForFuture" (2021–2024).

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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REFERENCES

Afeiche, M. C., Koyratty, B., Wang, D., Jacquier, E. F., & Lê, K. A. (2018). Intakes and sources of total and added sugars among 4 to 13-year-old children in China, Mexico and the United States. *Pediatric Obesity*, *13*(4), 204–212. https://doi.org/10.1111/ijpo.12234

Amies-Cull, B., Briggs, A. D. M., & Scarborough, P. (2019). Estimating the potential impact of the UK government's sugar reduction programme on child and adult health: Modelling study. *BMJ*, *365*, l1417. https://doi.org/10.1136/bmj.l1417

Ashwell, M., Gibson, S., Bellisle, F., Buttriss, J., Drewnowski, A., Fantino, M., … la Vecchia, C. (2020). Expert consensus on low-calorie sweeteners: Facts, research gaps and suggested actions. *Nutrition Research Reviews*, *33*, 145–154. https://doi.org/10.1017/S0954422419000283

Azad, M. B., Sharma, A. K., de Souza, R. J., Dolinsky, V. W., Becker, A. B., Mandhane, P. J., … Sears, M. R. (2016). Association between artificially sweetened beverage consumption during pregnancy and infant body mass index. *JAMA Pediatrics*, *170*(7), 662–670. https://doi.org/10.1001/jamapediatrics.2016.0301

Azaïs-Braesco, V., Sluik, D., Maillot, M., Kok, F., & Moreno, L. A. (2017). A review of total & added sugar intakes and dietary sources in Europe. *Nutrition Journal*, *16*(1), 6. https://doi.org/10.1186/s12937-016-0225-2

Bailey, R. L., Fulgoni, V. L., Cowan, A. E., & Gaine, P. C. (2018). Sources of added sugars in young children, adolescents, and adults with low and high intakes of added sugars. *Nutrients*, *10*(1), 102. https://doi.org/10.3390/nu10010102

Belc, N., Smeu, I., Macri, A., Vallauri, D., & Flynn, K. (2019). Reformulating foods to meet current scientific knowledge about salt, sugar and fats. *Trends in Food Science & Technology*, *84*, 25–28. https://doi.org/10.1016/j.tifs.2018.11.002

Bes-Rastrollo, M., Sayon-Orea, C., Ruiz-Canela, M., & Martinez-Gonzalez, M. A. (2016). Impact of sugars and sugar taxation on body weight control: A comprehensive literature review. *Obesity*, *24*(7), 1410–1426. https://doi.org/10.1002/oby.21535

Breda, J., Castro, L. S. N., Whiting, S., Williams, J., Jewell, J., Engesveen, K., & Wickramasinghe, K. (2020). Towards better nutrition in Europe: Evaluating progress and defining future directions. *Food Policy*, *96*, 101887. https://doi.org/10.1016/j.foodpol.2020.101887

Brown, R. J., De Banate, M. A., & Rother, K. I. (2010). Artificial sweeteners: A systematic review of metabolic effects in youth. *International Journal of Pediatric Obesity*, *5*(4), 305–312. https://doi.org/10.3109/17477160903497027

Burke, M. V., & Small, D. M. (2015). Physiological mechanisms by which non-nutritive sweeteners may impact body weight and metabolism. *Physiology & Behavior*, *152*, 381–388. https://doi.org/10.1016/j.physbeh.2015.05.036

Cediel, G., Reyes, M., da Costa Louzada, M. L., Martinez Steele, E., Monteiro, C. A., Corvalán, C., & Uauy, R. (2018). Ultra-processed foods and added sugars in the Chilean diet (2010). *Public Health Nutrition*, *21*(1), 125–133. https://doi.org/10.1017/S1368980017001161

Chi, D. L., & Scott, J. M. (2019). Added sugar and dental caries in children: A scientific update and future steps. *Dental Clinics*, *63*(1), 17–33. https://doi.org/10.1016/j.cden.2018.08.003

Coldwell, S. E., Oswald, T. K., & Reed, D. R. (2009). A marker of growth differs between adolescents with high vs. low sugar preference. *Physiology & Behavior*, *96*(4–5), 574–580. https://doi.org/10.1016/j.physbeh.2008.12.010

Committee on the Rights of the Child. (2013). *General comment no. 15 on the right of the child to the enjoyment of the highest attainable standard of health, CRC/C/GC/15*. New York: United Nations.

Dalenberg, J. R., Patel, B. P., Denis, R., Veldhuizen, M. G., Nakamura, Y., Vinke, P. C., … Small, D. M. (2020). Short-term consumption of sucralose with, but not without, carbohydrate impairs neural and metabolic sensitivity to sugar in humans. *Cell Metabolism*, *31*(3), 493–502. https://doi.org/10.1016/j.cmet.2020.01.014

Di Monaco, R., Miele, N. A., Cabisidan, E. K., & Cavella, S. (2018). Strategies to reduce sugars in food. *Current Opinion in Food Science*, *19*, 92–97. https://doi.org/10.1016/j.cofs.2018.03.008

Drewnowski, A. (2000). Sensory control of energy density at different life stages. *Proceedings of the Nutrition Society*, *59*(2), 239–244. https://doi.org/10.1017/S0029665100000264

Edwards, C. H., Rossi, M., Corpe, C. P., Butterworth, P. J., & Ellis, P. R. (2016). The role of sugars and sweeteners in food, diet and health: Alternatives for the future. *Trends in Food Science & Technology*, *56*, 158–166. https://doi.org/10.1016/j.tifs.2016.07.008

Elliott, C. (2015). 'Big Food' and 'gamified' products: Promotion, packaging, and the promise of fun. *Critical Public Health*, *25*(3), 348–360. https://doi.org/10.1080/09581596.2014.953034

Elliott, C. (2019). Tracking kids' food: Comparing the nutritional value and marketing appeals of child-targeted supermarket products over time. *Nutrients*, *11*(8), 1850. https://doi.org/10.3390/nu11081850

Elliott, C., & Truman, E. (2020). The power of packaging: A scoping review and assessment of child-targeted food packaging. *Nutrients*, *12*(4), 958. https://doi.org/10.3390/nu12040958

Farro, K., Montero, I., Vergara, E., & Ríos-Castillo, I. (2018). Elevado consumo de azúcares y grasas en niños de edad preescolar de Panamá: Estudio transversal. *Revista Chilena de Nutrición*, *45*, 7–16. https://doi.org/10.4067/s0717-75182018000100007

Forestell, C. A., & Mennella, J. A. (2007). Early determinants of fruit and vegetable acceptance. *Pediatrics*, *120*(6), 1247–1254. https://doi.org/10.1542/peds.2007-0858

Garrido-Miguel, M., Cavero-Redondo, I., Álvarez-Bueno, C., Rodríguez-Artalejo, F., Moreno, L. A., Ruiz, J. R., … Martínez-Vizcaíno, V. (2019). Prevalence and trends of overweight and obesity in European children from 1999 to 2016. A systematic review and meta-analysis. *JAMA Pediatrics*, *173*, e192430. https://doi.org/10.1001/jamapediatrics.2019.2430

Giménez, A., Saldamando, L. D., Curutchet, M. R., & Ares, G. (2017). Package design and nutritional profile of foods targeted at children in supermarkets in Montevideo, Uruguay. *Cadernos De Saude Publica*, *33*, e00032116. https://doi.org/10.1590/0102-311x00032116

Glanville, E. V., Kaplan, A. R., & Fischer, R. (1964). Age, sex and taste sensitivity. *Journal of Gerontology*, *19*, 474–478. https://doi.org/10.1093/geronj/19.4.474

Han, P., Bagenna, B., & Fu, M. (2019). The sweet taste signalling pathways in the oral cavity and the gastrointestinal tract affect human appetite and food intake: A review. *International Journal of Food Sciences and Nutrition*, *70*(2), 125–135. https://doi.org/10.1080/09637486.2018.1492522

Hashem, K. M., He, F. J., & MacGregor, G. A. (2019). Effects of product reformulation on sugar intake and health—A systematic review and meta-analysis. *Nutrition Reviews*, *77*(3), 181–196. https://doi.org/10.1093/nutrit/nuy015

Herrick, K. A., Fryar, C. D., Hamner, H. C., Park, S., & Ogden, C. L. (2020). Added sugars intake among US infants and toddlers. *Journal of the Academy of Nutrition and Dietetics*, *120*(1), 23–32. https://doi.org/10.1016/j.jand.2019.09.007

Huang, Y., Kypridemos, C., Liu, J., Lee, Y., Pearson-Stuttard, J., Collins, B., … Mozaffarian, D. (2019). Cost-effectiveness of the US Food and Drug Administration added sugar labeling policy for improving diet and health. *Circulation*, *139*(23), 2613–2624. https://doi.org/10.1161/CIRCULATIONAHA.118.036751

Hutchings, S. C., Low, J. Y. Q., & Keast, R. S. J. (2019). Sugar reduction without compromising sensory perception. An impossible dream? *Critical Reviews in Food Science and Nutrition*, *59*(14), 2287–2307. https://doi.org/10.1080/10408398.2018.1450214

Jacques, A., Chaaya, N., Beecher, K., Ali, S. A., Belmer, A., & Bartlett, S. (2019). The impact of sugar consumption on stress driven, emotional and addictive behaviors. *Neuroscience & Biobehavioral Reviews*, *103*, 178–199. https://doi.org/10.1016/j.neubiorev.2019.05.021

James, C. E., Laing, D. G., & Oram, N. (1997). A comparison of the ability of 8-9-year-old children and adults to detect taste stimuli. *Physiology & Behavior*, *62*, 193–197. https://doi.org/10.1016/S0031-9384(97)00030-9

Karalexi, M. A., Mitrogiorgou, M., Georgantzi, G. G., Papaevangelou, V., & Fessatou, S. (2018). Non-nutritive sweeteners and metabolic health outcomes in children: A systematic review and meta-analysis. *The Journal of Pediatrics*, *197*, 128–133.e2. https://doi.org/10.1016/j.jpeds.2018.01.081

Khan, T. A., Ayoub-Charette, S., Sievenpiper, J. L., & Comelli, E. M. (2020). Non-nutritive sweeteners and their effects on human health and the gut microbiome. In *Encyclopedia of gastroenterology* (2nd ed.). Cambridge, Massachusetts: Academic Press. https://doi.org/10.1016/B978-0-12-801238-3.62162-1

Lei, L., Rangan, A. M., Flood, V. M., & Louie, J. C. Y. (2016). Dietary intake and food sources of added sugar in the Australian population. *British Journal of Nutrition*, *116*(6), 1136. https://doi.org/10.1017/S0007114516003093

Li, X. E., Lopetcharat, K., & Drake, M. (2014). Extrinsic attributes that influence Parents' purchase of chocolate Milk for their children. *Journal of Food Science*, *79*(7), S1407–S1415. https://doi.org/10.1111/1750-3841.12515

Li, X. E., Lopetcharat, K., Qiu, Y., & Drake, M. A. (2015). Sugar reduction of skim chocolate milk and viability of alternative sweetening through lactose hydrolysis. *Journal of Dairy Science*, *98*(3), 1455–1466. https://doi.org/10.3168/jds.2014-8490

Liem, D. G., & de Graaf, C. (2004). Sweet and sour preferences in young children and adults: Role of repeated exposure. *Physiology & Behavior*, *83*(3), 421–429. https://doi.org/10.1016/j.physbeh.2004.08.028

Liem, D. G., & Mennella, J. A. (2002). Sweet and sour preferences during childhood: Role of early experiences. *Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology*, *41*(4), 388–395. https://doi.org/10.1002/dev.10067

Lima, M., Ares, G., & Deliza, R. (2019). Comparison of two sugar reduction strategies with children: Case study with grape nectars. *Food Quality and Preference*, *71*, 163–167. https://doi.org/10.1016/j.foodqual.2018.07.002

Ludwig, D. S. (2007). Childhood obesity—The shape of the things to come. *New England Journal of Medicine*, *357*, 2325–2327. https://doi.org/10.1056/NEJMp0706538

Ma, Y., He, F. J., Yin, Y., Hashem, K. M., & MacGregor, G. A. (2016). Gradual reduction of sugar in soft drinks without substitution as a strategy to reduce overweight, obesity, and type 2 diabetes: A modelling study. *The Lancet Diabetes & Endocrinology*, *4*(2), 105–114. https://doi.org/10.1016/S2213-8587(15)00477-5

MacGregor, G. A., & Hashem, K. M. (2014). Action on sugar—Lessons from UKsalt reduction programme. *The Lancet*, *383*(9921), 929–931. https://doi.org/10.1016/S0140-6736(14)60200-2

Mandrioli, D., Kearns, C. E., & Bero, L. A. (2016). Relationship between research outcomes and risk of bias, study sponsorship, and author financial conflicts of interest in reviews of the effects of artificially sweetened beverages on weight outcomes: A systematic review of reviews. *PLoS One*, *11*, e0162198. https://doi.org/10.1371/journal.pone.0162198

Martínez, X., Zapata, Y., Pinto, V., Cornejo, C., Elbers, M., Graaf, M. V., … Echeverría, G. (2020). Intake of non-nutritive sweeteners in Chilean children after enforcement of a new food labeling law that regulates added sugar content in processed foods. *Nutrients*, *12*(6), 1594. https://doi.org/10.3390/nu12061594

Marty, L., Chambaron, S., Nicklaus, S., & Monnery-Patris, S. (2018). Learned pleasure from eating: An opportunity to promote healthy eating in children? *Appetite*, *120*, 265–274. https://doi.org/10.1016/j.appet.2017.09.006

Martyn, D., Darch, M., Roberts, A., Lee, H. Y., Yaqiong Tian, T., Kaburagi, N., & Belmar, P. (2018). Low-/no-calorie sweeteners: A review of global intakes. *Nutrients*, *10*(3), 357. https://doi.org/10.3390/nu10030357

McCain, H. R., Kaliappan, S., & Drake, M. A. (2018). Invited review: Sugar reduction in dairy products. *Journal of Dairy Science*, *101*(10), 8619–8640. https://doi.org/10.3168/jds.2017-14347

Meldrum, D. R., Morris, M. A., & Gambone, J. C. (2017). Obesity pandemic: Causes, consequences, and solutions-but do we have the will? *Fertility and Sterility*, *107*, 833–839. https://doi.org/10.1016/j.fertnstert.2017.02.104

Mennella, J. A., & Bobowski, N. K. (2015). The sweetness and bitterness of childhood: Insights from basic research on taste preferences. *Physiology & Behavior*, *152*, 502–507. https://doi.org/10.1016/j.physbeh.2015.05.015

Mennella, J. A., Finkbeiner, S., & Reed, D. R. (2012). The proof is in the pudding: Children prefer lower fat but higher sugar than do mothers. *International Journal of Obesity*, *36*(10), 1285–1291. https://doi.org/10.1038/ijo.2012.51

Moore, J. B., Sutton, E. H., & Hancock, N. (2020). Sugar reduction in yogurt products sold in the UKbetween 2016 and 2019. *Nutrients*, *12*(1), 171. https://doi.org/10.3390/nu12010171

Moss, M. (2013). *Salt sugar fat. How the food giants hooked us*. New York: Random House.

Muth, M. K., Karns, S. A., Mancino, L., & Todd, J. E. (2019). How much can product reformulation improve diet quality in households with children and adolescents? *Nutrients*, *11*(3), 618. https://doi.org/10.3390/nu11030618

Nicklaus, S., & Remy, E. (2013). Early origins of overeating: Tracking between early food habits and later eating patterns. *Current Obesity Reports*, *2*(2), 179–184. https://doi.org/10.1007/s13679-013-0055-x

Nicklaus, S., Boggio, V., Chabanet, C., & Issanchou, S. (2004). A prospective study of food preferences in childhood. *Food Quality and Preference*, *15*(7), 805–818. https://doi.org/10.1016/j.foodqual.2004.02.010

Paglia, L., Friuli, S., Colombo, S., & Paglia, M. (2019). The effect of added sugars on children's health outcomes: Obesity, obstructive sleep apnea syndrome (OSAS), attention-deficit/hyperactivity disorder (ADHD) and chronic diseases. *European Journal of Paediatric Dentistry*, *20*(2), 127–132. https://doi.org/10.23804/ejpd.2019.20.02.09

Perrar, I., Schmitting, S., Della Corte, K. W., Buyken, A. E., & Alexy, U. (2020). Age and time trends in sugar intake among children and adolescents: Results from the DONALD study. *European Journal of Nutrition*, *59*(3), 1043–1054. https://doi.org/10.1007/s00394-019-01965-y

Popkin, B. M., & Reardon, T. (2018). Obesity and the food system transformation in Latin America. *Obesity Reviews*, *19*(8), 1028–1064. https://doi.org/10.1111/obr.12694

Popkin, B. M., & Hawkes, C. (2016). Sweetening of the global diet, particularly beverages: Patterns, trends, and policy responses. *The Lancet. Diabetes & Endocrinology*, *4*(2), 174–186. https://doi.org/10.1016/S2213-8587(15)00419-2

Powell, E. S., Smith-Taillie, L. P., & Popkin, B. M. (2016). Added sugars intake across the distribution of US children and adult consumers: 1977-2012. *Journal of the Academy of Nutrition and Dietetics*, *116*(10), 1543–1550. https://doi.org/10.1016/j.jand.2016.06.003

Public Health England. (2017). *Sugar reduction: Achieving the 20% a technical report outlining progress to date, guidelines for industry, 2015 baseline levels in key foods and next steps*. London: Public Health England. Retrived from. https://www.gov.uk/government/publications/sugar-reduction-achieving-the-20

Public Health England. (2020). *Sugar reduction. Report on progress between 2015 and 2019*. London: Public Health England. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/925027/SugarReportY3.pdf

Rauber, F., Louzada, M., Martinez Steele, E., Rezende, L., Millett, C., Monteiro, C. A., & Levy, R. B. (2019). Ultra-processed foods and excessive free sugar intake in the UK: A nationally representative cross-sectional study. *BMJ Open*, *9*(10), e027546. https://doi.org/10.1136/bmjopen-2018-027546

Reed, D. R., Mainland, J. D., & Arayata, C. J. (2019). Sensory nutrition: The role of taste in the reviews of commercial food products. *Physiology & Behavior*, *209*, 112579. https://doi.org/10.1016/j.physbeh.2019.112579

Reeve, B., & Magnusson, R. (2015). Food reformulation and the (neo)-liberal state: New strategies for strengthening voluntary salt reduction programs in the UK and USA. *Public Health*, *129*(4), 351–363. https://doi.org/10.1016/j.puhe.2015.01.007

ReportLinker. (2020). *Global kids' food and beverages industry*. Lyon: ReportLinker.

Rito, A. I., Dinis, A., Rascôa, C., Maia, A., de Carvalho Martins, I., Santos, M., … Stein-Novais, C. (2019). Improving breakfast patterns of Portuguese children—An evaluation of ready-to-eat cereals according to the European nutrient profile model. *European Journal of Clinical Nutrition*, *73*(3), 465–473. https://doi.org/10.1038/s41430-018-0235-6

Rozin, P. (1984). The acquisition of food habits and preferences. In J. D. Mattarazzo (Ed.), *Behavioral Health: A Handbook of Health Enhancement and Disease Prevention* (Vol. 1984, pp. 590–607). New York: Wiley.

Sahin, A. W., Zannini, E., Coffey, A., & Arendt, E. K. (2019). Sugar reduction in bakery products: Current strategies and sourdough technology as a potential novel approach. *Food Research International*, *126*, 108583. https://doi.org/10.1016/j.foodres.2019.108583

Sambra, V., López-Arana, S., Cáceres, P., Abrigo, K., Collinao, J., Espinoza, A., … Gotteland, M. (2020). Overuse of non-caloric sweeteners in foods and beverages in Chile: A threat to consumers' free choice? *Frontiers in Nutrition*, *7*, 68. https://doi.org/10.3389/fnut.2020.00068

Saper, C. B., Chou, T. C., & Elmquist, J. K. (2002). The need to feed: Homeostatic and hedonic control of eating. *Neuron*, *36*(2), 199–211. https://doi.org/10.1016/S0896-6273(02)00969-8

Struck, S., Jaros, D., Brennan, C. S., & Rohm, H. (2014). Sugar replacement in sweetened bakery goods. *International Journal of Food Science & Technology*, *49*(9), 1963–1976. https://doi.org/10.1111/ijfs.12617

Spencer, G. (2014). *Empowerment, health promotion, and young people—A critical approach*. New York, NY: Routledge.

Suez, J., Korem, T., Zeevi, D., Zilberman-Schapira, G., Thaiss, C. A., Maza, O., … Kuperman, Y. (2014). Artificial sweeteners induce glucose intolerance by altering the gut microbiota. *Nature*, *514*(7521), 181–186. https://doi.org/10.1038/nature13793

Sullivan, S. A., & Birch, L. L. (1990). Pass the sugar, pass the salt: Experience dictates preference. *Developmental Psychology*, *26*(4), 546–551. https://doi.org/10.1037/0012-1649.26.4.546

Sutaria, S., Devakumar, D., Yasuda, S. S., Das, S., & Saxena, S. (2019). Is obesity associated with depression in children? Systematic review and meta-analysis. *Archives of Disease in Childhood*, *104*, 64–74. https://doi.org/10.1136/archdischild-2017-314608

Swithers, S. E. (2015). Artificial sweeteners are not the answer to childhood obesity. *Appetite*, *93*, 85–90. https://doi.org/10.1016/j.appet.2015.03.027

Sylvetsky, A. C., Welsh, J. A., Brown, R. J., & Vos, M. B. (2012). Low-calorie sweetener consumption is increasing in the United States. *The American Journal of Clinical Nutrition*, *96*(3), 640–646. https://doi.org/10.3945/ajcn.112.034751

Toews, I., Lohner, S., de Gaudry, D. K., Sommer, H., & Meerpohl, J. J. (2019). Association between intake of non-sugar sweeteners and health outcomes: Systematic review and meta-analyses of randomised and non-randomised controlled trials and observational studies. *BMJ*, *364*, k4718. https://doi.org/10.1136/bmj.k4718

UNICEF, WHO, The World Bank. (2020). *Levels and trends in child malnutrition: Key findings of the 2020 edition of the joint child malnutrition estimates*. Geneva: World Health Organization.

UNICEF. (1989). *Convention on the rights of the child*. New York: UNICEF.

UNICEF. (2019). *The state of the world's children 2019. Children, food and nutrition. Growing well in a changing world*. New York: UNICEF.

Velázquez, A. L., Vidal, L., Alcaire, F., Varela, P., & Ares, G. (2020). Significant sugar-reduction in dairy products targeted at children is possible without affecting hedonic perception. *International Dairy Journal*, *114*, 104937. https://doi.org/10.1016/j.idairyj.2020.104937

Velázquez, A. L., Vidal, L., Varela, P., & Ares, G. (2020). Cross-modal interactions as a strategy for sugar reduction in products targeted at children: Case study with vanilla milk desserts. *Food Research International*, *130*, 108920. https://doi.org/10.1016/j.foodres.2019.108920

Veldhuizen, M. G., Babbs, R. K., Patel, B., Fobbs, W., Kroemer, N. B., Garcia, E., … Small, D. M. (2017). Integration of sweet taste and metabolism determines carbohydrate reward. *Current Biology*, *27*(16), 2476–2485. https://doi.org/10.1016/j.cub.2017.07.018

Vennerød, F. F. F., Almli, V. L., Berget, I., & Lien, N. (2017). Do parents form their children's sweet preference? The role of parents and taste sensitivity on preferences for sweetness in pre-schoolers. *Food Quality and Preference*, *62*, 172–182.

Vennerød, F. F. F., Nicklaus, S., Lien, N., & Almli, V. L. (2018). The development of basic taste sensitivity and preferences in children. *Appetite*, *127*, 130–137.

Voorberg, W. H., Bekkers, V. J. J. M., & Tummers, L. G. (2015). A systematic review of co-creation and co-production: Embarking on the social innovation journey. *Public Management Review*, *17*, 1333–1357.

Vos, M. B., Kaar, J. L., Welsh, J. A., Van Horn, L. V., Feig, D. I., Anderson, C. A. M., … Johnson, R. K. (2017). Added sugars and cardiovascular disease risk in children: A scientific statement from the American Heart Association. *Circulation*, *135*(19), e1017–e1034. https://doi.org/10.1161/CIR.0000000000000439

Vyth, E. L., Hendriksen, M. A. H., Roodenburg, A. J. C., Steenhuis, I. H. M., van Raaij, J. M. A., Verhagen, H., … Seidell, J. C. (2012). Consuming a diet complying with front-of-pack label criteria may reduce cholesterol levels: A modeling study. *European Journal of Clinical Nutrition*, *66*(4), 510–516. https://doi.org/10.1038/ejcn.2011.193

Wang, J. W., Mark, S., Henderson, M., O'Loughlin, J., Tremblay, A., Wortman, J., … Gray-Donald, K. (2013). Adiposity and glucose intolerance exacerbate components of metabolic syndrome in children consuming sugar-sweetened beverages: QUALITY cohort study. *Pediatric Obesity*, *8*(4), 284–293. https://doi.org/10.1111/j.2047-6310.2012.00108.x

Weihrauch-Blüher, S., Schwarz, P., & Klusmann, J.-H. (2019). Childhood obesity: Increased risk for cardiometabolic disease and cancer in adulthood. *Metabolism Clinical and Experimental*, *92*, 147–152. https://doi.org/10.1016/j.metabol.2018.12.001

Wittekind, A., & Walton, J. (2014). Worldwide trends in dietary sugars intake. *Nutrition Research Reviews*, *27*(2), 330–345. https://doi.org/10.1017/S0954422414000237

Woloson, W. A. (2002). *Refined tastes: Sugar, confectionery, and consumers in nineteenth-century America*. Baltimore, Maryland: JHU Press.

World Health Organization (2017). World Health Organization: Incentives and disincentives for reducing sugar in manufactured foods. In *An exploratory supply chain analysis*. Copenhagen: WHO Regional Office for Europe.

World Health Organization. (2015). *Guideline: Sugars intake for adults and children*. Geneva: World Health Organization.

Yasaki, T. (1976). Study on sucrose taste thresholds in children and adults. *Journal of Dental Health*, *26*, 20–25.

Yeung, C. H. C., Gohil, P., Rangan, A. M., Flood, V. M., Arcot, J., Gill, T. P., & Louie, J. C. Y. (2017). Modelling of the impact of universal added sugar reduction through food reformulation. *Scientific Reports*, *7*(1), 17392. https://doi.org/10.1038/s41598-017-17417-8

How to cite this article: Velázquez, A. L., Vidal, L., Varela, P., & Ares, G. Sugar reduction in products targeted at children: Why are we not there yet? *J Sens Stud*. 2021;36:e12666. https://doi.org/10.1111/joss.12666