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Paths for reducing sugar intake in Portugal: Main findings from the SUGAR Project

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ABSTRACT: Overconsumption of free sugars is associated with an increased risk of non-communicable diseases. Given that about one-fourth of the Portuguese adult population exceeds the WHO's free sugars intake limit, examining consumers' perceptions and practices regarding sugar intake becomes relevant. Here we review the main findings of the SUGAR project that used a multimethod approach to investigate this issue. Our studies show that, overall, people hold negative attitudes towards sugar, recognize some of its negative outcomes for human health, and favor the implementation of governmental strategies to reduce this consumption. Nonetheless, our data suggest ambivalence toward sugar intake and low knowledge about the topic (e.g., difficulty in identifying sugars in ingredient lists; unawareness of sugar intake guidelines). By identifying knowledge gaps and sources of bias related to sugar consumption, our results can be informative for developing interventions to reduce the consumption of free sugars.

1 THE SUGAR PROJECT: RELEVANCE AND SCOPE

Poor eating habits contribute to a decrease in average life expectancy and have been associated with many health conditions. The excessive intake of sugars is characteristic of such inadequate eating habits, contributing to increasing overall energy intake while reducing the intake of nutritionally richer foods (Mela & Woolner, 2018). The negative impact of excessive consumption of free sugars – that is, all "… monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices, and fruit juice concentrates" on health seems to be particularly prominent (World Health Organization [WHO], 2015, p. 1). Specifically, overconsumption of this type of sugar has been associated with the risk of developing non-communicable diseases (e.g., overweight or obesity, cardiometabolic diseases, some types of cancer, dental caries), many of which are prevalent in Portugal (for a review, see Prada, Saraiva, Garrido, et al., 2022).

Based on the evidence linking sugar consumption and adverse health outcomes, several health authorities have issued sugar intake guidelines (for a review, see Mela & Woolner, 2018). The WHO's guidelines state that free sugars intake should be limited to less than 10% (ideally 5%) of the total daily energy intake (WHO, 2015). To illustrate, for a person with a 2000Kcal/daily intake, free sugars intake should be lower than 50 gr per day. At first sight, this threshold might seem quite high. However, consumers often focus on table sugar (e.g., the amount of sugar they add to coffee), underestimating the amount of sugar in the food or beverages available at the supermarket or the hospitality industry (Prada, Godinho, et al., 2021). For example, drinking a single can of soda can contribute to about 70% of the WHO's daily free sugars intake limit. Indeed, free sugars seem to be ubiquitous in current food offer (Acton et al., 2017; Popkin & Hawkes, 2016), not only in sweet products (e.g., soft drinks, cookies) as well as in less obvious products (e.g., canned foods; bread). Hence, it is not surprising that sugar intake patterns are worrisome in multiple countries (Azaïs-Braesco et al., 2017), and Portugal is no exception. According to recent data, 24% of Portuguese adults, 41% of children, and 49% of adolescents' sugar intake exceeds the recommended amount (Lopes et al., 2017)

In this chapter, we summarize the findings of a project that aims to contribute to addressing this

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issue by examining the extent to which Portuguese consumers':

1. Understand the anticipated health consequences of excessive sugar intake;
2. Are aware of governmental interventions to reduce sugar intake and, if so, if they accept these interventions;
3. Prioritize information about sugar content and know about sugar intake guidelines;
4. Are knowledgeable about which ingredients constitute sugar sources;
5. Are influenced by claims about the amount or type of sugar in processed foods;
6. Can infer the sugar content of real-life products and how perceived sugar content modulates the perception of other attributes (e.g., caloric content, perceived taste).

2 MAIN FINDINGS

2.1 *Perceived associations between excessive sugar intake and health*

Excessive sugar intake represents an increased risk of developing non-communicable diseases (e.g., obesity, cardiometabolic diseases, dental diseases; Mela & Woolner, 2018). Yet, it is unclear whether people are aware of these adverse health outcomes (cf., Park et al., 2018).

We have conducted two qualitative studies that provide insights into this issue. One of these studies (Prada, Godinho, et al., 2021) used focus groups with a sample of 40 Portuguese college students. Overall, participants shared the view that sugar is not harmful if eaten in moderation. Still, they identified as potential consequences obesity, diabetes, cardiovascular diseases, skin problems, and general conditions (e.g., sugar as a cause of inflammation). The other study (Prada, Saraiva, Godinho, et al., 2021) presents the findings obtained from 42 interviews with Portuguese parents, showing that participants associated children's excessive sugar intake with similar conditions (e.g., obesity, diabetes, oral health problems), also emphasizing other issues (e.g., agitation, inattention, and hyperactivity). However, individuals sometimes downplay the impact of the adverse consequences of excessive sugar intake (e.g., considering it is less harmful than other nutrients or substances such as fat or preservatives) or acknowledge the potential negative health outcomes but believe that they will not experience them (Miller et al., 2020; Prada, Godinho, et al., 2021).

To assess the anticipated consequences of excessive sugar intake, we asked Portuguese individuals to freely report all health conditions they associated with such overconsumption and then rate the strength of these associations for eight specific health conditions (Prada, Saraiva, Garrido, et al., 2022). Most participants (79%) reported at least one health condition associated with excessive sugar intake (a total of 1812 health conditions were coded by two expert judges). The most frequent associations were related to risk factors for cardiovascular diseases (e.g., diabetes, obesity, hypercholesterolemia). Still, associations to cardiovascular diseases (e.g., stroke, heart attack/myocardial infarction, arteriosclerosis), oral health problems (e.g., cavities), oncological (e.g., cancer), and mental health conditions (e.g., depression, anxiety, fatigue) were also widespread. Moreover, participants rated all the indicated health conditions as highly associated with excessive sugar intake, particularly diabetes, overweight/obesity, and oral problems.

2.2 *Knowledge and acceptance of interventions aiming to reduce sugar intake*

Public perception of governmental interventions has the potential to shape the design, implementation, and compliance with a given policy (e.g., Reynolds et al., 2019). The few studies that specifically focused on the public acceptance of actions aimed at reducing sugar intake included samples of British and American (Petrescu et al., 2016) and Swiss participants (Hagmann et al., 2018). To examine public knowledge and acceptance of interventions in Portugal (Prada, Rodrigues, et al., 2020), we asked participants to indicate all the interventions to reduce sugar intake they could recall and to indicate the level of agreement with the set of eight interventions described in Hagmann et al.'s study (2018).

Our findings showed that only about one-third of the participants could remember at least one intervention. Interventions related to increased prices or taxation for high-sugar products (particularly soft drinks); reduction in the weight of individual sugar packets; and limited availability of products offered in health care or education facilities were the most frequently mentioned. Moreover, participants reported accepting all interventions (e.g., public health campaigns, sugar reduction in products, portion size reduction, taxation) apart from the one proposing sugar replacement by artificial sweeteners. The most accepted intervention was the one related to explicitly labeling sugar content on food packaging.

Overall, participants were very receptive to the implementation of interventions aimed at reducing sugar intake and reported positive attitudes toward the need to address excessive sugar intake in Portugal.

2.3 *Perceived importance of information about sugar content and knowledge about sugar intake guidelines*

Despite the efforts of governments worldwide to comply with the current sugar intake guidelines, the goal is far from being reached. Thus, it becomes highly relevant to explore the extent to which these guidelines are well known among the general

population. Previous research with Canadian (Vanderlee et al., 2015) and Northern Irish participants (Tierney et al., 2017) suggests this is not the case.

We examined awareness of the guidelines as well as the importance (and frequency of use) of information about sugar content (Prada, Saraiva, et al., 2020). We observed that participants indicated that sugar content is the most important attribute in the nutritional information panel to watch out to stay healthy, consulting it more frequently than other indicators (e.g., caloric content). However, participants were unaware of intake guidelines. Specifically, almost two-thirds of the sample responded that they did not know about these guidelines or heard about them but did not remember the exact limit of sugar intake. Those who did provide an estimate indicated that the guidelines ranged from 0 to almost 100 g of sugar per day. Moreover, participants were moderately confident in their ability to understand the definition of free sugars, but less so regarding the ability to recognize this type of sugar in products. These findings point out the need to further examine consumer knowledge about sugar sources.

2.4 *Knowledge about sugar sources*

Research suggests that increasing knowledge about sugar is associated with reduced consumption of food and beverages with sugar (Gase et al., 2014; Lee & Joo, 2016; Park et al., 2018). Critically, consumers' knowledge about this topic tends to be low.

We adapted a task developed by Tierney et al. (2017) and asked participants to categorize a set of 15 sugar sources described according to two criteria: composition (i.e., intrinsic vs. added/free sugars) and origin (i.e., natural sugar vs. artificial sweetener; Prada, Saraiva, et al., 2020). They could also select an "*I don't know*" option. According to the scenario presented (i.e., list of ingredients of packaged cookies), all items were sources of added sugar, and all were natural except for aspartame and saccharine. Overall accuracy was inferior to 50% in both cases, such that lactose, fructose, and glucose were frequently miscategorized as intrinsic sources of sugar. Moreover, although aspartame and saccharine obtained the highest frequencies of artificial responses, responses were still below the 50% threshold. Participants also often incorrectly categorized other sugar sources as artificial, namely fruit concentrate corn syrup or xylitol. It is also interesting the high percentage of participants that mentioned being unsure (i.e., "*I don't know*" responses) about the categorization of ingredients like xylitol or maltose in both criteria.

Summing up, accuracy in the sugar source categorization task was far from ideal, and participants actually seemed to recognize this lack of knowledge as they often indicated not being able to categorize a given item. Our results also indicate consumers' receptivity to certain ingredients, as consumers tend to mistrust food additives, viewing them as less natural and healthy (Szűcs et al., 2019).

2.5 *Impact of cues related to the amount and type of sugar on consumers' perception of products*

Previous studies have suggested that nutritional claims (i.e., statements about a particular nutritional characteristic of the product) may help consumers make healthier and informed food decisions (for reviews, see Kaur et al., 2017; Talati et al., 2017). This is only possible if the consumer can correctly interpret them. Critically, that is often not the case (Anastasiou et al., 2019). For instance, claims may mislead consumers (Roe et al., 1999) when they attribute excessive health benefits to a food product or infer the healthiness of a product solely based on the presence of the claim (e.g., Kaur et al., 2017). A curious example is the positive effect of a fictitious claim ("MUI-free") on perceived healthiness (Priven et al., 2015). Moreover, consumers may overlook potentially negative attributes (e.g., high sugar) due to the presence of positive claims (e.g., "with calcium" (Hastak & Mazis, 2011; Wellard et al., 2015). For example, a systematic comparison of thousands of products has shown that products labeled as "reduced calories", "light", and "low fat" present higher sugar content than their "regular" counterparts (Nguyen et al., 2016).

Claims about sugar may refer to the quantity (e.g., a "low sugar" food must contain up to 5gr of sugar per 100 gr of product) or the quality (e.g., "with coconut sugar") of this nutrient. Previous research has suggested that both types of sugar-related claims can promote the perception that the product is healthier (Nobrega et al., 2020; Sütterlin & Siegrist, 2015) or has fewer calories (Patterson et al., 2012). However, these claims may also lead to negative expectations for other attributes such as taste (Lähteenmäki et al., 2010; Nørgaard & Brunsø, 2009; Raaij et al., 2009).

In a recent study (Prada, Saraiva, Sério, et al., 2021), we sought to systematically examine how different types of claims about sugar influenced the perception of food product categories (i.e., yogurts, ice creams, cookies, and breakfast cereals). In two experiments (combined n = 406), we asked participants to evaluate the perceived healthfulness, caloric value, and expected taste of products with (vs. without) sugar-related claims. Specifically, the claims were on the sugar content ("0% sugar", "sugar-free", "no added sugars", "low sugar" - Experiment 1) or the type of sugars or sweeteners of natural origin ("sucrose", "cane sugar", "honey" and "stevia" - Experiment 2).

Results from Experiment 1 revealed that all products with claims about reduced sugar content were rated as healthier, less caloric, and less tasty than the regular alternatives. Still, products with the comparative claim (i.e., "low sugar") were perceived as the

least healthy, most caloric, and tastiest. The impact of claims related to the type of sugar (Experiment 2) was not as straightforward, varying according to the specific claim and evaluative dimension (e.g., products with stevia rated as healthier, less caloric, and less tasty; products with honey simultaneously rated as healthier and tastier). In general, the ratings did not depend on the product category, suggesting that the impact of claims may be generalized to other product categories. We also observed that, for both experiments, the frequency of consumption of products with sugar-related claims was positively associated with the general perception of these products, the influence of nutritional information on consumption decisions, attention to sugar intake, and interest in nutrition.

Overall, our results show that sugar-related claims may influence consumers' perceptions about food products, but the direction of that influence depends on the type of claim and evaluative dimension. Noteworthy, claims about sugar content led to perceive the products as more healthful and less caloric. Hence, a potential caveat is that the mere inclusion of nutrition claims may result in overconsumption (for a review, see Brown et al., 2018) which is particularly concerning for nutritionally poor products. Moreover, the negative expectations regarding the taste of products –sometimes described as the "Health-Pleasure" trade-off (e.g., Loebnitz & Grunert, 2018) - may be detrimental to consumers' purchase intention and consumption patterns of these types of products. Finally, a limitation of our experiments is that, although we contextualized the claims using four food categories, the claims were not paired with specific food exemplars. Because food packaging often includes myriad clues, the claims may become less salient. Hence, it is important to test how different cues influence consumer perception of real-life food products.

2.6 *Impact of perceived sugar content on consumers' perception of food exemplars*

Food packages are designed with different visual (e.g., shape, layout, size, illustrations) and informational attributes (e.g., characteristics of the product) that may influence the processing of information regarding the product (for reviews, see Hallez et al., 2020; Silayoi & Speece, 2007). This information is often the basis for inferences about the credibility of a product (and its manufacturer; for a review on credence cues, see Fernqvist & Ekelund, 2014). Besides branding attributes, credence cues include a) statements about the beneficial nutritional properties of the product (e.g., "low sugar") and/or how it may impact consumers' health (e.g., "Calcium may reduce the risk of osteoporosis"); b) attributes related to the food origin, production method, and ethical or environmental concerns (e.g., country of origin, organic farming, fair trade, animal welfare); and c) descriptive food names (e.g., names that elicit sensory experiences or appeal to memories and tradition.

Aiming to examine the relationship between these packaging cues and the nutritional quality of the product, namely sugar content, we decided to focus on a single category - breakfast cereals. These are ultra-processed foods (Cordain et al., 2005), which, despite typically containing high amounts of sugar, energy, sodium content, and saturated fat, are highly heterogeneous in terms of their nutritional quality (Chepulis et al., 2017; Nieto et al., 2017; Priebe & McMonagle, 2016). Hence, consumers must be able to distinguish between less healthy and healthy food alternatives, namely those with lower sugar content.

In a recent study (Prada, Saraiva, Viegas, et al., 2021), we analyzed 289 exemplars of breakfast cereals from two major retailers in Portugal and collected information on their nutritional profile (e.g., sugar, salt, fiber per 100g), price, packaging features, and type of food claims presented (e.g., statements about the composition, sensory features, the origin of the product) and ingredients list. Overall, the sugar content of breakfast cereals was high (M = 19.9g), and less than 10% of the products complied with the current national guidelines (i.e., 5g of sugar per 100g of product). Sugar sources were listed in the top three ingredients for over 85% of the products, using multiple designations (sugar, sucrose, beet/cane/coconut/organic sugar, malt, syrups, etc.). On average, each product included about four claims, and sugar content was lower when the claims were related to the product composition. Critically, the sugar content was particularly high for children-oriented products (M = 26.4g). Products with higher sugar content also were cheaper and had lower quantities of fiber, proteins, and salt. Our findings suggest the need to implement strategies to reduce sugar in this product category (e.g., incentive manufacturers to reformulate products).

Based on these findings, we became interested in examining how consumers perceive the nutritional profile of a product based solely on the information provided in the packaging. This mimics what often occurs in naturalistic contexts, as consumers usually do not have the resources and/or motivation to comprehensively analyze the nutritional information facts panel (WHO, 2017). High consumption of breakfast cereals may be due to the lack of awareness regarding their sugar content. Therefore, we conducted two studies (Prada, Saraiva, Viegas, et al., 2022) in which we selected exemplars from our previous study to investigate the relationship between perceived and objective sugar content.

In Study 1 (n = 90), all the exemplars were high in sugar, whereas in Study 2 (n = 85), exemplars contained low, moderate, or high sugar content. Study 1 revealed that participants accurately perceived all exemplars as containing high sugar. Study 2 showed that participants were able to distinguish between different sugar content levels. For example, overall, participants' categorization of each product according to

the nutritional traffic light system was accurate (e.g., around 60% of products with objective high sugar content [over 22.5 gr of sugar per 100 gr of product] were correctly categorized as "red"). Notably, perceived sugar content also impacted how participants evaluated the products in other dimensions. Besides being rated as having more sugar, products with objective high (vs. moderate or low) sugar content were perceived as tastier, as having more fat and calories, but also as less healthful. Participants who perceived the exemplars as containing more sugar also reported using nutritional information more often and consuming these products less frequently.

Taken together, these findings suggest that, when instructed to do so, consumers seem to be able to recognize the sugar content of the product exemplars, even when they consider that they belong to a category that is typically high in sugar. Yet, this does not imply that they understand how much sugar they are ingesting per portion of a given product (e.g., on average Portuguese consumers of breakfast cereals eat 1.5 portions daily (Lopes et al., 2017) nor how that portion contributes to the total daily sugar intake. Notably, as our results suggest, knowledge may not be the only factor to consider when addressing the problem of excessive sugar intake (for a review, see Gupta et al., 2018). Future studies should also explore the motivations for consuming these products (e.g., hedonic or convenience aspects) and consider these motivations when designing interventions to empower consumers to make healthier food choices (e.g., providing alternatives that are equally tasty and accessible).

3 CONCLUSIONS

Our findings suggest that Portuguese individuals seem to be aware of the potential negative outcomes of excessive sugar intake, prioritize information about sugar content, and agree with governmental interventions to address this issue. Nonetheless, they also report difficulties in identifying certain ingredients as sources of sugar and, in general, are unaware of sugar intake guidelines. Moreover, claims about sugar content (or type of sugar) may modulate the way consumers perceive products. By focusing on products available in the market (breakfast cereals), we also observed that, although the range of sugar content is wide, on average, products are not complying with current national and international guidelines for sugar content.

Reducing the intake of free sugars in the population is a complex issue that, besides governmental action, demands the engagement of other parties in the food system, such as the production industry, retailers, the hospitality sector, and the media (Evans, 2017). Change may be attained by implementing strategies such as population education (e.g., national dietary guidelines), point-of-purchasing labeling (e.g., food package nutrition fact panels), fiscal (dis)incentives (e.g., soft drinks taxes), industry quality standards (e.g., mandatory or recommended limits for sugar, trans fat, etc.), and food marketing standards (e.g., limited marketing towards children of products that fail to meet nutrition standards; Mozaffarian et al., 2018; Popkin & Hawkes, 2016).

The findings of the SUGAR project are relevant to inform policymakers, educators, and health professionals and support interventions aiming to promote healthier eating habits and reduce sugar intake.

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