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A qualitative study about college students' attitudes, knowledge and perceptions regarding  
sugar intake

Marília Prada<sup>1</sup>

Cristina A. Godinho<sup>2,3</sup>

Margarida V. Garrido<sup>1</sup>

David L. Rodrigues<sup>1</sup>

Inês Coelho<sup>1</sup>

Diniz Lopes<sup>1</sup>

<sup>1</sup>Iscte-Instituto Universitário de Lisboa, CIS-iscte, Lisboa, Portugal

<sup>2</sup>Direção-Geral da Saúde, Lisboa, Portugal

<sup>3</sup>Universidade Católica Portuguesa, CRC-W: Católica Research Centre for Psychological, Family and Social Wellbeing

Note: Marília Prada, Cristina Godinho, Margarida V. Garrido, David L. Rodrigues, Inês Coelho and Diniz Lopes, Department of Social and Organizational Psychology, Iscte-Instituto Universitário de Lisboa, CIS-iscte, Lisboa.

Correspondence concerning this article should be addressed to M. Prada, Iscte-Instituto Universitário de Lisboa, Av. das Forças Armadas, Office AA.110, 1649-026, Lisboa, Portugal. E-mail: [marilia\\_prada@iscte-iul.pt](mailto:marilia_prada@iscte-iul.pt)

### **Abstract**

Excessive sugar intake has been associated to multiple health conditions (e.g., higher risk for non-communicable diseases). Hence, health organizations have issued guidelines defining the maximum daily intake of free or added sugars. However, data from several countries suggests that these guidelines are rarely met, particularly by young adults. For example, almost half of Portuguese adolescents and young adults exceed the recommended sugar intake. In this work, we aim to further explore college students' attitudes, knowledge and perceptions about sugar intake, as well as about sugar intake guidelines. A thematic content analysis on data from five focus groups ( $n = 40$ ) indicated that participants reported difficulty in the comprehension of added/free sugars definition and sugar intake recommendations. Overall, attitudes toward sugar were ambivalent. Sugar was simultaneously perceived as pleasurable and needed, but also as addictive and harmful. Although aware of the potential negative health outcomes associated to excessive sugar intake, most participants did not perceive being at risk due to their youth, exercise habits or type of diet. The few concerns expressed were mostly associated to the negative impact of high sugar intake on body image (e.g., weight gain). The main barriers to reducing sugar intake identified were environmental (e.g., time restrictions, food available at the university). Still, participants could identify several individual strategies to effectively regulate sugar intake. By identifying knowledge gaps and sources of bias related to sugar consumption, our findings are useful to inform future interventions aiming to address the problem of high sugar intake among university students.

**Keywords:** sugar, food perception, college students, qualitative study, focus groups

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## 1. Introduction

The association between individuals' diet and health is currently indisputable, with unhealthy dietary habits being one of the main risk factors contributing to the burden of disease worldwide (Lim et al., 2012). For instance, the excessive intake of sugar, particularly of added and free sugars, has been recurrently associated with several non-communicable diseases, such as type 2 diabetes (de Koning et al., 2011; Malik et al., 2010), overweight and obesity (e.g., Keller & Bucher Della Torre, 2015; Malik et al., 2013; Te Morenga et al., 2012) and oral health problems (Moynihan, 2016; Moynihan & Kelly, 2014). In the face of this evidence, independent health authorities, such as the World Health Organization (WHO), the Scientific Advisory Committee on Nutrition (SACN) in the United Kingdom, and the Dietary Guidelines Advisory Committee (DGAC) in the United States, have issued guidelines to limit the amount of daily free or added sugar intake. For example, the WHO guidelines focus on free sugars (i.e., "monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook or consumer", as well as "sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates", WHO, 2015, p. 4). According to those guidelines, less than 10% of the total energy intake should come from free sugars, and a further reduction of such intake to less than 5% has been included as a conditional recommendation.

Although only a few studies have examined the intake of free sugars with nationally representative samples, the evidence suggests that a great proportion of the population in developed countries does not follow the above recommendations. For instance, in Switzerland, 55% of adults aged 30-64 and 64% of those aged 18-29 do not comply with the WHO guidelines (Chatelan et al., 2019). In other countries, studies showed such incidence to be 67% in men and 71% in women in the Netherlands (Sluik et al., 2016), 41% of the adult population in France (Lluch et al., 2017) and 25% in Spain (Ruiz et al., 2017). Although these results cannot be directly compared (e.g., differences in sample selection criteria), taken

26 together, data from different countries point to the urgent and global need of understanding  
27 and addressing the high prevalence of free sugar intake for the prevention of chronic illnesses  
28 and conditions.

29 In Portugal, data from a recent food survey with a nationally representative sample  
30 showed that 24.1% of adults do not comply with the WHO guidelines. These numbers were  
31 even higher among children (40.7%) and particularly worrisome among adolescents and  
32 young adults (i.e., 48.7%, Lopes et al., 2017). This latter segment of the population stands out  
33 for its significantly higher consumption of sugar sweetened beverages (SSBs), compared to  
34 other age groups. Moreover, those enrolled in higher education showed the highest  
35 consumption of sugary foods such as sweets, cakes and cookies (Lopes et al., 2017). There is  
36 evidence that, globally, young adults tend to have lower diet quality than other age groups,  
37 which is associated to major life transitions during this period (for a review, see Ashton et al.,  
38 2019). For example, the transition to college has been identified as a particularly challenging  
39 stage, with frequent changes in dietary patterns that often lead to additional weight gain  
40 during college years (de Vos et al., 2015; Deliens et al., 2013; Finlayson et al., 2012).

41 Previous studies have highlighted a myriad of individual (e.g., psychological) and  
42 contextual factors (e.g., physical and social) contributing to sugar intake. For example, liking  
43 for sugary food seems to vary according to the individuals' knowledge and attitudes towards  
44 sugar (Gupta et al., 2018) and dietary habits (Tan & Tucker, 2019). The presence of sugar in  
45 processed foods is also pervasive, and the intensive marketing and wide availability of  
46 products with high sugar-content at a low-cost has rendered the current food environment  
47 "obesogenic" (Barquera et al., 2018; Osei-Assibey et al., 2012; Swinburn et al., 1999). People  
48 with low social-economic background are especially vulnerable to these contextual factors  
49 (Forde & Solomon-Moore, 2019; Rehm et al., 2008; Thompson et al., 2009). From the  
50 consumers' perspective, even for those highly motivated, making good dietary choices is not

51 an easy task. For example, the existence of over 150 different names for sugar, referring to  
52 different sugar sources and types, render the choice of healthy food products quite  
53 challenging (Bernstein et al., 2016). Moreover, knowledge about the recommended maximum  
54 daily intake of sugar is still limited (Tierney et al., 2017), especially among younger people  
55 (Chatelan et al., 2019; Gupta et al., 2018; Miller et al., 2020; Vanderlee et al., 2015).

56 Previous qualitative studies with college students have already identified some factors  
57 associated with the high consumption of specific high-sugar products, namely SSBs (Block et  
58 al., 2013; Hattersley et al., 2009; Miller et al., 2020). For instance, Hattersley et al. (2009)  
59 results suggested that high SSBs consumption is perceived as normative among this age  
60 group being promoted by environmental cues (e.g., highly marketed and availability in young  
61 participants social settings). Moreover, Block et al. (2013) found that SSBs was mainly  
62 driven by taste, as well as their association with treats, rewards and caffeine content. Indeed,  
63 in that study, the impact of health and nutritional aspects on beverage choice was only limited  
64 and many participants were not even aware of the calorie content of different beverages.  
65 Importantly, health concerns regarding sodas were mostly related to the chemicals included  
66 in their composition and not as much to sugar content (Block et al., 2013). Other studies (e.g.,  
67 Brownbill et al., 2020; De Vlieger et al., 2017) have also suggested that perceived naturalness  
68 may be more important to determine how nutritious or healthful it is a given product.  
69 Moreover, Brownbill et al. (2020) found that although participants mentioned that the type  
70 (i.e., natural vs. added) and quantity of sugar are important cues to understand whether a  
71 beverage is healthy or not, many lacked the knowledge about how much sugar from which  
72 beverages are harmful for health. Likewise, in another recent study, Miller et al. (2020)  
73 showed that participants had little knowledge about sugar content and sugar intake  
74 recommendations. For instance, although participants acknowledged that beverages like  
75 sodas and energy drinks are high in sugar, and that sugar content may vary according to

76 product, accurate identification of sugar content for any beverage type was scant. Most  
77 participants were also unaware of the recommendations about SSBs consumption, and  
78 estimates were inconsistent (e.g., for some one can per day would be excessive, whereas  
79 others indicated two or three).

80 Most of these qualitative studies have focused only on SSBs and little is still known  
81 about the knowledge, beliefs and attitudes that college students hold in relation to sugar  
82 intake in its various forms, their perceptions about the sugar content in different foods and on  
83 their knowledge of the maximum recommended daily intake of sugar. Hence, the present  
84 study aimed to explore these aspects on a sample of Portuguese undergraduate students,  
85 which are in a life stage characterized by more autonomy regarding food purchase and  
86 preparation (Nelson et al., 2008), but where levels of sugar intake tend to peak. An in-depth  
87 understanding of the factors underlying sugar consumption, as well as the barriers and  
88 facilitators to the regulation of its intake, may contribute to develop interventions and  
89 strategies for reducing sugar intake in a segment of the population among which this intake is  
90 particularly high. Furthermore, because dietary habits have shown to persist into adulthood,  
91 reducing sugar consumption among young individuals is also important to reduce the risk for  
92 negative health outcomes latter on (Winpenny et al., 2017).

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## 2. Method

### 95 2.1 Participants

96 Forty Portuguese undergraduate students (BAs in Psychology and in Sociology), 31  
97 women and 9 men ( $M = 20.27$  years,  $SD = 4.66$ ) participated in the study, receiving a partial  
98 credit as compensation. Most participants indicated to follow an omnivorous diet ( $n = 35$ ,  
99 87.5%), while three were vegan and the remaining two followed other non-specified type of  
100 diet. Over half of the sample ( $n = 28$ , 67.5%) reported a normal weight ( $18.5 < BMI < 24.9$ ),

101 three were underweight (i.e., BMI < 18.5) and seven were overweight or obese (BMI > 25)<sup>1</sup>.  
102 Most participants ( $n = 30$ , 75%) did not identify as the main food shopper for the household,  
103 although they indicated influencing the purchase of food for the household ( $M = 4.81$ ,  $SD =$   
104  $1.69$ , IC 95% [4.25, 5.37]). Only six participants indicated they were the main food shopper  
105 and four mentioned they shared this responsibility with another family member.

106 Overall, participants reported being interested in food and nutrition ( $M = 4.80$ ,  $SD =$   
107  $1.56$ , IC 95% [4.30, 5.30]). Most participants ( $n = 33$ , 82.5%) reported eating less than five  
108 portions of fruits and vegetables per day. Still, participants self-assessed their current dietary  
109 habits as moderately healthy ( $M = 4.15$ ,  $SD = 1.19$ , IC 95% [3.77, 4.53]). Only four  
110 participants referred having a specific health condition that impacts their eating habits (i.e.,  
111 intolerance to lactose and gluten, hypercholesterolemia and bulimia). Participants also  
112 reported having an active lifestyle ( $M = 4.53$ ,  $SD = 1.36$ , IC 95% [4.09, 4.96]) and perceived  
113 themselves as being in good health ( $M = 4.88$ ,  $SD = 0.99$  IC 95% [4.56, 5.19]).

114

## 115 2.2 Measures

116 The final questionnaire assessed socio-demographic variables (age, gender,  
117 nationality) as well as questions related to participants' diet, lifestyle and health. Specifically,  
118 we asked participants to identify their current diet ("omnivorous", "vegetarian", "vegan",  
119 "weight-loss" or "other"), weight and height. Next, we asked participants to indicate who is  
120 the main food shopper for their household ("themselves", "mother", "father", "partner" or  
121 "other"). Whenever participants were not the main shopper, they were asked to indicate to  
122 what extent they influence the purchase of food for the household (1 = *Little influence* to 7 =  
123 *Great influence*). We then asked participants to indicate their interest in food and nutrition (1  
124 = *Little interested* to 7 = *Very interested*) and about their daily fruits and vegetables intake

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<sup>1</sup> The BMI was not calculated for two participants, as they did not report their weight.

125 (i.e., “In a typical day, do you eat more/less than the recommended 5 portions of fruits and  
126 vegetables? – “I eat less than 5 portions”; “I eat more than 5 portions”; and “I don’t know”).  
127 We also asked participants to assess the healthfulness of their current dietary habits (1= *Not*  
128 *healthy at all* to 7= *Very healthy*), to indicate whether they suffer from any diagnosed health  
129 condition that limits their diet, how active is their lifestyle (1= *Very sedentary* to 7= *Very*  
130 *active*) and their health status (1= *Very bad* to 7 = *Very good*).

### 131 **2.3 Procedure**

132 After the approval of the ethics committee of [Insert host institution], we conducted  
133 five focus groups with seven to nine participants each. All participants were recruited through  
134 the University’s subject pool and received partial course credit for their participation in the  
135 study. In the registration platform the study was described in general terms (i.e., “group  
136 interview about college students’ food habits and preferences”) and all students that were  
137 Portuguese (or spoke Portuguese fluently) were eligible for participation. The sessions were  
138 conducted in the Psychology Lab (between November 26 and December 7 2018), in a room  
139 with a one-way mirror, by two trained moderators. Participants were also informed that the  
140 sessions were audio-recorded and that another researcher was in the adjacent room taking  
141 notes to facilitate transcription work.

142 After presenting the general goals of the study, the functioning of the focus group and  
143 the ethical issues regarding their participation, written informed consent was obtained from  
144 all participants. Each session lasted, on average, for 1h 30m. At the end, participants were  
145 presented with a brief questionnaire assessing sociodemographic information, as well as  
146 dietary and health-related data. Debriefing emphasized that the main goal of the study was to  
147 explore college students’ attitudes, knowledge and perceptions regarding sugar intake.

### 148 **2.4 Interview Schedule**



149 All sessions followed a semi-structured interview questionnaire schedule comprising  
150 four blocks:

151 1. General eating habits: This block aimed to work as an icebreaker. Participants were  
152 asked to introduce themselves and talk about their eating habits (e.g., whether they usually  
153 cook and/or buy what they eat; what influences their daily food choices, etc.).

154 2. Processed food products: In this block we explored participants' perceptions of  
155 processed foods, including the potential influence of packaging (e.g., design; materials) and  
156 labelling aspects (e.g., frequency of use of nutritional information; type of information  
157 prioritized) on food choice. We also explored which cues they use to infer the healthiness of  
158 food products.

159 3. Sugar consumption: The main goal was to understand participants' views about  
160 different types of sugar and sugar consumption, and what were the main barriers and  
161 facilitators in relation to sugar intake. We also aimed to understand which strategies  
162 participants use or thought would be important to use to limit their sugar intake, and which  
163 products they associated with high / low content of sugar. We also explored their knowledge  
164 regarding sugar sources and limits on consumption recommended by health authorities, such  
165 as the WHO.

166 4. Interventions to reduce sugar consumption: The last block addressed participants'  
167 knowledge, acceptance and perceived efficacy of different governmental interventions and  
168 policies designed to reduce sugar intake in the Portuguese population. We also asked  
169 participants about new measures that, in their opinion, should be implemented.

## 170 **2.5 Data Analysis**

171 The content of the focus groups was transcribed verbatim and the subsequent thematic  
172 analysis was supported by QSR NVivo 12 software. All names were removed from the texts  
173 and replaced by numbers to ensure participants' anonymity.

174           The six steps defined by Braun and Clarke (2006) were followed in the analysis. The  
175 first phase of the analysis consisted on the familiarization with the data, through the  
176 transcription of the audio of the interviews, and by reading and re-reading of all transcripts by  
177 two of the research team members. The second phase consisted on the generation of initial  
178 codes and definitions, in order to organize the data and to find patterns and similarities between  
179 them. This process was mostly data-driven (i.e., an essentially inductive process), although a  
180 few codes – related to the determinants of eating – were anchored in theoretical models (i.e.,  
181 Theoretical Domains Framework, Cane, O'Connor, & Michie, 2012).

182           Subsequently, after discussion of the initial codes among all team members, all data  
183 were coded in an iterative way, with coding units being defined semantically. The first three  
184 focus groups transcripts were independently coded by two researchers and the following two  
185 by one researcher. In this process, broader themes were defined in relation to the study  
186 objectives, allowing to group it into a thematic coding tree. The fourth phase consisted on the  
187 refinement of the coding tree, based on consensus, through the discussion among team  
188 members familiar with the data, namely through the merging of some themes, separation a few  
189 codes and sub-codes and others being discarded. In the next phase, a thematic tree with all  
190 themes, definitions, codes and sub-codes, with one or two examples of each was developed.  
191 The sixth and final phase consisted in presenting the product of the analysis in a simple,  
192 concise, coherent and logical manner. The final output of this phase is presented in the next  
193 section. To identify participants' contributions, for each quote, we indicate focus group session  
194 number (FG#), if the participant identified as male (M) or female (F) and their age.

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### 3. Results

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Results regarding sugar consumption were organized into five main themes (see Table 1) which are described below: attitudes and beliefs about sugar intake; barriers and

199 facilitators for sugar intake; motivations and strategies for reducing sugar intake;  
200 perceptions regarding the presence of sugar in specific foods; knowledge regarding sugar  
201 sources and recommendations about sugar intake.

### 202 **3.1 Attitudes and Beliefs about Sugar Intake**

203 Overall, attitudes regarding sugar intake were rather ambivalent. On the one hand,  
204 participants expressed their love for sweets (*“It’s great!”*, FG2:M/18) and how tempting  
205 and pleasurable it was to eat sugary foods. On the other hand, they referred to sugar  
206 intake as being “terrible” and frequently used words such as “poison”, “addiction”,  
207 “vice” and even “*bogeyman*” to describe it. For instance, one participant mentioned: *“I*  
208 *think sugar is extremely processed. I think the sugar levels [in food] are really*  
209 *ridiculous and I think it is... Okay, I think sugar is delicious, isn't it?! I think it's*  
210 *fantastic, it's “God forbid, but I wish I could...!”* (FG4:F/22). Also, sugar intake was  
211 described as an addiction, in the sense that the body becomes insatiable, always  
212 demanding higher doses: *“Because our body always wants more, more and more.*  
213 *Because this is a false energy that is given. A person reaches very high energy peaks, but*  
214 *then reaches (...) a low... (...) And then it requires even more sugar - it is a vicious*  
215 *cycle... Okay, I think it's terrible and I think it just tends to get worse.”* (FG4:F/22).

216 All participants shared the view that sugar is essential for the normal functioning  
217 of the body, and that, as long as it is eaten in moderation, it is not harmful, even when  
218 considering added sugars: *“It just has to be right, isn't it? Nor can we cut radically.”*  
219 (FG2:M/20). Some referred that the right quantity varies according to the individual, as  
220 some have the need to consume higher amounts than others. An increased need for  
221 sugary products may also occur in specific situations, such as having to study, after  
222 exercising, at the end of the day, during menstruation, or, more generally, whenever one  
223 is tired, stressed, bored or needs energy. Several comments implied some type of

224 compensatory beliefs related to sugar consumption. For instance, eating sugary foods is  
225 viewed as a way to compensate for negativity (“*I think that we share that idea that*  
226 *‘today, I deserve it’ because something went wrong or whatever*”, FG1:F/20) or for  
227 effort (“I am studying hard, I deserve having some [sweets]”, FG4:M/19). Other  
228 participants seem to justify eating sugar due to their dietary (e.g., being vegan –“*I*  
229 *already gave up meat... so, sometimes, I end up choosing some things that are less*  
230 *healthy because I also know that it won’t matter much*” FG3:F/19) or exercise habits  
231 (“*If I am going to the gym, I will prefer something with more sugar because it is fast*  
232 *sugar so I’ll have more energy...*”, FG2:F/22).

233         A distinction in relation to different sources of sugar was also frequently made to  
234 support that sugar intake was not necessarily bad and was - to some extent - necessary,  
235 and hence that not all sugar can be cut down. Sugar present in fruits was frequently  
236 mentioned in this regard and considered to be “good sugar”, whereas “processed sugars”,  
237 such as those present in cakes or cookies, were regarded as unhealthy: “*I think if we are*  
238 *careful about the quantities (...) fruit, for example, has a lot of sugar. Probably a better*  
239 *sugar than the one we usually eat ... But I don't know if that’s enough. I'm not an expert*  
240 *on the subject, but I think sugar itself is always necessary for our bodies. So, to cut down*  
241 *on some of the sugar sources, I think we need to slightly increase other sources, namely,*  
242 *fruits*” (FG4:F/18). However, one participant mentioned that – despite the generalized  
243 idea that fruit can be eaten without limits, this is not actually the case, and that sugar  
244 from fruit should also be limited. Brown sugar was also regarded as healthier than white  
245 sugar.

246         Weight gain was one of the most frequently referred consequences of sugar intake  
247 and, because of that, a matter of concern for many participants. Some participants also  
248 referred that sugar intake is associated with the onset of various health problems (e.g.,

249 obesity, diabetes, cardiovascular diseases and skin problems) and can cause  
250 inflammation in different parts of the body. However, the negative health consequences  
251 of sugar intake were sometimes downplayed by participants, by comparing it to the  
252 effect of other substances or by discrediting the evidence. Namely, sugar was deemed as  
253 a lesser evil than antidepressants or preservatives (*“For example, the preservatives are*  
254 *much worse than the sugar there is in a simple cake, which sometimes doesn't hurt at*  
255 *all...”*; FG1:M/41), or other nutrients (e.g., *“In cookies, the worst is the fat (laughs). I*  
256 *think even worse than sugar is the amount of fat...”*, FG4:F/19). Also, sugary foods were  
257 not viewed as the sole determinants of weight gain (e.g., *“Just because I don't eat, for*  
258 *example, sugar, if I eat half a loaf of bread in a day, I'll also get fat, I'll also have effects*  
259 *that I don't want.”*; FG5:M/20). Some participants also expressed mistrust regarding  
260 evidence on the negative consequences of sugar intake, considering that the news often  
261 reveal the results of (supposedly) scientific studies showing contradictory results: *“The*  
262 *information we receive about, for example, the effects of sugar or the harm it causes, is*  
263 *very varied and one is not sure what to believe ... Now there are studies that say this,*  
264 *sometimes there are studies that say that. And sometimes it's not exactly studies, so you*  
265 *really don't know.”* (FG4:F/17).

### 266 **3.2 Barriers and Facilitators for Sugar Intake**

267 When reflecting on the factors determining their intake of sugar, some  
268 participants referred that the most important was what others (especially family  
269 members) ate, even more than media advertisements. Many participants mentioned that  
270 health was not something they considered when choosing food (including sugary  
271 products). Instead, they privileged what was cheaper (*“It's a matter of choosing the*  
272 *cheapest option that will feed us better”*, FG3:F/18) or what would make them feel good  
273 (*“... I don't really care what is healthy or not, I care about what makes me happy”*,

274 FG2:F/19).

275 Another important factor was flavor, in the sense that sugar can make everything  
276 taste better. In contrast, a few participants also referred that a sweet taste can be  
277 associated with decreased consumption, as sugar may cover up the real flavor of food or  
278 that excessive sweetness can be unpleasant. Pleasure (or anticipated pleasure) and  
279 expectations regarding feeling good when eating sugary foods were also important: “*I*  
280 *think a lot that if I'm going to eat something with sugar or more sugar, it has to be worth*  
281 *it (laughs). That is, it is worth it if I feel good eating that... So, the amount also has to do*  
282 *with me feeling good ... If I eat for eating makes no sense (laugh), I can choose another*  
283 *thing. But if it's worth it, if I'm going to feel good, if it makes sense at the moment, I think*  
284 *I'll eat it.*”, FG3:F/20).

285 Having little time to eat between classes and the food offer at the university were  
286 frequently referred as barriers for eating healthier and consuming low levels of sugar.  
287 One participant mentioned that even products that could constitute healthier choices  
288 were only available at the university (e.g., vending machines) in less healthier versions  
289 (e.g., rice or corn cracker with chocolate toppings). Importantly, drinking coffee was  
290 perceived as a main source of free/added sugars and was both referred as an opportunity  
291 and a barrier to reduce sugar intake. Specifically, it was deemed as a barrier to  
292 participants referring being difficult not to add sugar to coffee or substituting it by other  
293 sweeteners, and as an opportunity for those willing to do so.

### 294 **3.3 Motives and Strategies to Reduce Sugar Intake**

295 Wanting to lose weight, either for health or appearance reasons or being an  
296 athlete were the most referred motives to reduce sugar intake. Another reason was the  
297 possibility of having a specific health condition. However, in this regard, some  
298 participants acknowledged that even in such situations they tended to “cheat” and ate

299 sugary foods on the sly.

300 A few participants argued that reducing sugar intake is relatively easy as it is  
301 totally under the individuals' control (*"If we try to reduce it slowly, I think it will taste*  
302 *much better. It's no big effort."* FG3:F/18). Yet, most considered reducing sugar a  
303 difficult task as sugar is perceived as being virtually in every food as well as a task that  
304 requires a lot of effort and self-control to avoid falling into temptation. Also, when cut  
305 drastically, withdrawal symptoms may be experienced (e.g., bad humor, irritation,  
306 headaches). As argued by one participant, maintaining some flexibility can be important  
307 in order to attain long-term goals: *"To think it doesn't have to be all or nothing... I am*  
308 *remembering the example of my father, who is an overweight person who is always*  
309 *struggling to avoid such foods. I think what has helped him in recent times is thinking*  
310 *that he does not need to withdraw completely."* (FG3:F/18). In the same vein, another  
311 participant mentioned that trying to reduce sugar gradually may be a good strategy to  
312 decrease the total amount of consumed sugar.

313 Others mentioned that it is a matter of habit and that when one starts cutting off  
314 sugar from food and drinks, it may be actually hard to consume these products with  
315 higher sugar quantity. Others referred to the importance of developing healthy eating  
316 habits during childhood, when tastes are still being established.

317 One participant referred that it is a matter of choosing the right options (even for  
318 indulgent foods) and that the challenge is more on being able to control how much one  
319 eats: *"... You have chocolate that is good, and you have chocolate that is not good. The*  
320 *point is: for chocolate that is healthy to eat, which is dark chocolate, you can only eat 3*  
321 *tiny bits a day...3! And "Ah, but this doesn't bring me satisfaction!", That's the real*  
322 *problem, is that you are not happy with those 3..."* (FG5:M/20).

323 Regarding specific strategies for reducing sugar intake, participants identified

324 cooking at home and reducing the amount of sugar they added to foods and beverages or  
325 substituting sugar by natural sweeteners, such as honey (e.g., when baking). They also  
326 mentioned avoiding adding sugar to coffee or tea, although one participant mentioned  
327 this strategy was not very consistent/effective: *“I do not use sugar in coffee, but I*  
328 *commit the stupidity of having a custard tart with my coffee, oh well...”* (FG5:M/41).  
329 Others mentioned substituting foods by less caloric or lower sugar content options (e.g.,  
330 fresh fruit juices vs. packed juices; having fruit as dessert), even if this may imply  
331 spending more money. Other strategies included avoiding eating sugary products for  
332 breakfast or with an empty stomach or setting weekly limits for some foods.

333         Some participants mentioned they actively searched for information on nutrition  
334 and related to sugar intake on the internet, and many mentioned that sugar content was  
335 one the things they paid most attention to on nutrition labels. Only one participant  
336 referred not paying much attention because they only purchase/ intake the specific  
337 products recommended by a nutritionist.

### 338 **3.4 Perceptions Regarding the Presence of Sugar in Specific Foods**

339         Among the product-categories most frequently identified as high in sugar content  
340 were chewing-gums, cakes, SSBs (especially coke, as well as iced tea - which some  
341 referred to be often considered a healthier option, but also fruit juices and energy drinks),  
342 chocolate, cookies, breakfast cereals (especially those targeted at children, but also  
343 others that may have a more healthy appearance or are marketed for weight loss). Less  
344 frequently mentioned products were baby porridges, and sugar added to fast food meat  
345 and buns.

346         In contrast, as examples of foods with low levels of sugar participants mentioned  
347 whole or “natural” food products, fruit (especially organic), and bread (especially dark  
348 bread), but also Marie biscuits and corn/rice crackers. However, a few mentioned that



349 these crackers were not very healthy due to their salt content, and that whole products  
350 can also be misleading: *“we always tend to associate them [whole food products] with*  
351 *less sugar, but then there are some types... There are cookies that say they are whole*  
352 *and then if we compare the labels, the sugars sometimes are even higher than other*  
353 *cookies that are not whole.”* (FG1:F/18).

354 Participants also mentioned that the sugar content of certain food products might  
355 be surprising. Ketchup was a frequently cited example and many participants also  
356 reported that they were shocked when they realized the amount of sugar that is actually  
357 present in children’ breakfast cereals, granola and in different juices and sodas. For  
358 example, *“(...) I remember that in my high school ... They displayed the soda cans and*  
359 *they put the amount of sugar contained on it ahead of them. And when we see the*  
360 *numbers, it's hard to tell. But when we really see the amount of sugar, we think "How*  
361 *come are we eating so much sugar?!" I imagined eating that in spoons... I could not*  
362 *possibly eat it! Although it is contained in the soda. That was pretty scary for me.”*  
363 (FG4:F/18). Another participant also mentioned that realizing that sugar is the main  
364 ingredient of certain products (certain cakes and jams) was very surprising. Bread and  
365 processed meat were also given as examples of products regarding which participants  
366 did not understand why they had to have added sugar.

367 Others mentioned that nearly all processed foods contain sugar: *“Whether we like*  
368 *it or not, everything that is processed will have [sugar]...”* (FG4:F/18). Hence,  
369 following from this discussion, some participants expressed to be confused as to whether  
370 other savory foods such as chips and salt crackers had sugar (or not). Indeed, many  
371 participants expressed the view that sugar is not only present in sweets, but in most food  
372 products: *“Honestly, I think almost everything has sugar, nowadays (...) Even the*  
373 *normal things that we think that have no sugar always end up with a little sugar...”*

374 (FG2:M/20).

375 Most participants expressed difficulty in knowing whether or not a certain food  
376 contained sugar. Still, they discussed different strategies to identify sugar content in  
377 products, such as: categorization of food as savory versus sweet, considering these  
378 categories as mutually exclusive; using the area of the supermarket as a cue, namely  
379 inferring that products sold in the “diet and lifestyle” areas contain less sugar; and  
380 making decisions based on food production method (organic products deemed as  
381 containing “more natural” and “less processed” sugars). However, a few others referred  
382 it was easy to know when food had (or not) sugar, as long as one knew how to read  
383 nutritional tables present in the packages. A participant stated that nutritional  
384 information could prevent consumers from being biased by other cues (e.g., health  
385 claims) that could be misleading.

### 386 **3.5 Knowledge regarding Sugar Sources and Recommendations on Sugar Intake**

387 Very few participants distinguished between sugars that are added to foods either  
388 by the manufacturer, cook or consumer, and sugars that are naturally present in foods.  
389 None has spontaneously labelled the former as “added sugars”. When provided with the  
390 definition, they agreed that most of the products available today include added sugar, but  
391 that this information tends to be concealed and that, even when presented on the  
392 nutritional tables, it is hard to understand. One of the reasons is because there are many  
393 different types of sugar and that, when looking for sugar in the list of ingredients, they  
394 focus on sucrose, fructose, lactose and maltose. One participant also referred that some  
395 of these may be “hidden sources of sugar” and other mentioned that some preservatives,  
396 labelled as “E’s” can be sugars too.

397 A few participants indicated that they often look for sugar information in  
398 nutritional tables, but even those had difficulty in estimating sugar content of specific

399 products, or how much sugar would be too much. Some referred it was easier for them  
400 when the quantity of sugar was presented in percentage or in relation to the maximum  
401 daily intake. Many participants indicated that, when thinking about the quantity of added  
402 sugar in specific foods, it was easier for them when they thought in terms of the number  
403 of individual sugar packets. However, estimates regarding grams of sugar per packet  
404 varied across participants. Some estimates were 8 grs, others 10 grs and still others 3 to 6  
405 grs of sugar per packet<sup>2</sup>. Others said they would not use an “absolute reference value”  
406 but would rather use the total quantity of sugar to compare different products, selecting  
407 the one with lower sugar content. When considering alternative sources of sugar,  
408 participants mentioned using / buying products sweetened with stevia, brown sugar,  
409 honey, vanilla and artificial sweeteners.

410       None of the participants knew the recommendations from any health authority nor  
411 could correctly identify the daily limit of free sugar intake that is recommended by the  
412 WHO. One participant thought that it was 5 to 9 spoons, however unsure of whether  
413 these were coffee or tea spoons. After presenting the sugar intake guidelines it became  
414 obvious that participants had different interpretations of their meaning and implications.  
415 For example, many participants thought that the guidelines only referred to the sugar that  
416 is added by the consumer (most often “table sugar”). Hence, they excluded sugar that is  
417 added to processed foods by the manufacturers. Moreover, some participants thought  
418 that the guidelines were actually the recommended dietary allowance for sugar.

419       When exposed to the recommended maximum intake, participants expressed  
420 difficulties in understanding how much 50 or 25 grs of sugar actually are. Still, this was  
421 facilitated by anchoring this value in some familiar foods or drinks (e.g., the researcher  
422 indicated that a typical can of coke contains 35 grs of sugar). Some participants

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<sup>2</sup> In Portugal there are regulations defining that each individual sugar packet should not exceed 5/6 gr.



448 processed such as brown sugar) or “bad” (i.e., the “processed sugars” that are added  
449 by the industry, or by those preparing or eating sugary foods and/ or drinks).  
450 Previous qualitative research had also shown that people tend to perceive white  
451 sugar as “refined and unhealthy” and brown sugar and sugar in fruit as “more  
452 natural and healthier” (Patterson et al., 2012). This can, however, lead to a “health  
453 halo” regarding products containing these types of less refined sugar and fruit juices  
454 thereby contributing to increased sugar consumption, as highlighted in previous  
455 research (e.g., Block et al., 2013).

456         Moreover, although aware of the negative impact sugar intake may have on  
457 health, participants did not know the recommendations regarding the maximum  
458 daily intake of added/free sugars. Sugar was also perceived as a highly addictive  
459 substance, possibly owing to research disseminated on the media, namely  
460 establishing parallels between sugar consumption and drug addiction  
461 (DiNicolantonio et al., 2018; cf. Westwater et al., 2016). However, eating sugar “in  
462 moderation” was generally considered not only harmless, but actually necessary.  
463 Interestingly, it was very challenging for participants to provide estimates regarding  
464 the quantity of sugar that it would be acceptable to eat, even when asked to consider  
465 this in relation to specific products (see also, Miller et al., 2020; Patterson et al.,  
466 2012; Tierney et al., 2017). Moreover, when considering products high in sugar,  
467 college students tended to focus on sweets, namely cakes, chocolates, chewing  
468 gums, cookies and SSBs. They had difficulty in identifying “hidden sources of  
469 sugar”, namely that products categorized as “savory” or “healthy” can constitute  
470 sources of sugar, even when acknowledging that a considerable part of processed  
471 foods contains sugar. One important example concerns yogurts and fermented  
472 milks. Although these are the fifth source of free sugars consumed by the

473 Portuguese population (Lopes et al., 2017), they were seldomly referred by  
474 participants as products with high sugar content. These findings confirm that even  
475 well-educated young adults could benefit from nutrition education. They also  
476 support that nutrition information can be hard to understand and interpret, especially  
477 when this information is counter-intuitive or presented in a format that is not readily  
478 accessible (van Kleef et al., 2008). As a result, food purchasing / choice decisions  
479 may rely on heuristics (e.g., if it is a whole or organic product, or if it is savory or  
480 sweet), which can sometimes be misleading.

481         Sugar was also perceived as necessary for the good functioning of the body  
482 and as an important source of energy, especially for attaining some academic duties.  
483 Despite these common beliefs, carbohydrates from added sugars are not needed  
484 (Harvard School of Public Health, 2013). Indeed, the available evidence points to a  
485 detrimental effect of diets high in sugar on cognitive functions (e.g., Agrawal & Gomez-  
486 Pinilla, 2012; Chong et al., 2019) and to sucrose intake being associated with poorer  
487 cognitive performance (Ginieis et al., 2018). Hence, to capacitate individuals for  
488 change and to foster informed choices regarding sugar intake among university  
489 students, future interventions should aim to make a clear distinction between intrinsic  
490 and added sugars and specifically counteract these beliefs regarding their properties.  
491 Providing information on the heuristics people use to infer the sugar content of  
492 products and how they can sometimes be deceiving (e.g., a savory taste does not  
493 imply absence of sugar) also seems to be highly relevant, as well as developing  
494 formats to better communicate sugar content (e.g., instead of grams of sugar provide  
495 a well-known reference such as sugar packets). Lastly, our results also suggest the  
496 need for improving knowledge on the different sources of sugar and their health  
497 outcomes, as well as deconstructing the “health halos” associated with more

498 “natural” sources of sugar.

499         Several individual and contextual factors were identified as having an  
500 important influence on sugar consumption. Habit, enhanced flavor/ pleasure, having  
501 specific goals (e.g., weight-loss, performance in sports), and negative events and  
502 emotions were the most relevant individual factors, whereas social influence,  
503 limited time to eat and limited food offer were the main referred contextual factors.

504         Habit was frequently referred as a driver for sugar intake. In line with  
505 previous evidence (e.g., Kremers et al., 2007; Lanfer et al., 2012), there was a  
506 shared belief that habit formation can trace back to childhood - although it can also  
507 be developed later in life -, and that it is associated with taste preferences in terms  
508 of the amount of sugar one needs to put in specific foods (e.g., coffee). This is  
509 particularly relevant as past sugar consumption has been identified as the main  
510 predictor of sugar intake (e.g., Hagger et al., 2017). Sugar consumption was also  
511 referred as an important source of pleasure. Although some degree of ambivalence  
512 (i.e., a conflict aroused by competitive evaluative dispositions; Sparks et al., 2001) was  
513 found, the immediate pleasurable taste of sugar tended to be more valued than its  
514 negative health consequences, as underlined by other studies with samples of young  
515 adults (e.g., Block et al., 2013; Freeman & Sheiham, 1997). An “illusion of  
516 invulnerability” associated with age may explain, at least partially, these findings.  
517 Previous studies have shown that young adults tend to perceive lower levels of risk in  
518 relation to health outcomes (Johnson et al., 2002; Kim et al., 2018) and that, among  
519 samples of younger adults, risk perceptions had no substantial impact on intention or  
520 behavior, including nutritional behavior (Renner et al., 2000; Schwarzer & Renner,  
521 2000). Even when recognizing that excessive sugar intake is associated with different  
522 health risks, an optimistic bias (i.e., a bias in comparative risk perception regarding

523 oneself vs. others, Weinstein, 1980) seemed to be present.

524         Other motivations rather than health, such as concerns about weight gain and  
525 physical appearance, and having specific roles (e.g., being an athlete), were more  
526 important to these students. This suggests that more immediate outcomes are especially  
527 appealing for young adults, as they are more prone to “decision myopia” (Loewenstein  
528 et al., 2001), that is, the tendency to focus more on the immediate possibilities rather  
529 than in long-term risks (Gerrard et al., 2008). Hence, the tendency for downplaying the  
530 health risks of sugar and showing some mistrust in the information available on this  
531 topic were possibly ways of reconciling two perspectives (i.e., admitting that sugar can  
532 have negative health consequences, while not attributing it much importance). This bias  
533 in risk perception may contribute for these young adults to find little motivation in  
534 changing their patterns of sugar consumption. Thus, besides providing basic nutritional  
535 knowledge, interventions seeking to reduce sugar consumption among this population  
536 may have to work on this risk perception distortions and to take multifaceted approaches  
537 to persuasion, making reference to motives that are more important to young adults  
538 (e.g., worsened cognitive performance, weight gain) rather than focusing on health risks.

539         Participants also mentioned to be particularly prone to eating food with high  
540 sugar content when in stressful situations and/or experiencing negative feelings.  
541 Extensive evidence has demonstrated the use of hedonically rewarding foods as a  
542 coping strategy to deal with negative emotions, particularly among restrained eaters and  
543 binge eaters (for a meta-analysis, see Cardi et al., 2015). A more recent study has even  
544 shown that feelings of sadness can lead consumers to select and prepare foods with  
545 higher amounts of sugar (Lefebvre et al., 2019). Eating sugary products was also  
546 frequently mentioned as a self-reward. As a way to justify their high sugar intake and/or  
547 feeling less guilty or worry about their indulgence, some expressed “compensatory



548 health beliefs”. These pertain to beliefs that an unhealthy behavior can be compensated for  
549 by engaging in a healthy behavior, and were found to hinder health behavior change  
550 (Amrein et al., 2017). This has also been labelled in other literature as the “licensing  
551 effect” (Khan & Dhar, 2006), that is, when people allow themselves to do something  
552 “bad” (e.g., immoral or unhealthy) after doing something “good” (e.g., moral or  
553 healthy), including food choices (e.g., Chang & Lin, 2015; Prada et al., 2016; Prinsen et  
554 al., 2019). These compensatory beliefs or licensing effect may help to explain why some  
555 participants assumed they could eat more sugar, namely due to being vegan or because  
556 they practice physical exercise regularly.

557         Social influence was also mentioned as a factor impacting sugar  
558 consumption. Specifically, participants shared the view that living / eating with  
559 family members (as opposed to colleagues and peers) was associated with having  
560 healthier diets, lower in sugar (Lambert et al., 2019). Indeed, previous research has  
561 suggested that consumption of high-sugary products is perceived as normative  
562 among young individuals (e.g., Block et al., 2013). Participants also consistently  
563 mentioned barriers to healthy eating related to the university setting. Limited time to  
564 eat between classes and academic duties made them often choose fast food and  
565 ready to eat snacks, frequently poor from a nutritional point of view and with high  
566 sugar content. Indeed, lack of time to eat has been negatively associated with the  
567 nutritional quality of students meals (e.g., Betts et al., 1995; Larson et al., 2009) and  
568 the access to unhealthy snacks at the university setting (e.g., in vending  
569 machines) is pervasive and associated with increased consumption (Grech &  
570 Allman-Farinelli, 2015; Kubik et al., 2003). As in previous research (e.g., Roy et  
571 al., 2019; Tam et al., 2017), and aside from the limited variety of food offer,  
572 students also emphasized the role played by price, namely that very few healthy

573 options were available at a low price. Indeed, high sugar (and fat) foods tend to  
574 constitute the cheapest sources of energy (Headey & Alderman, 2019). Interventions on  
575 the offer and pricing of healthy foods in cafeterias and vending machines on campus  
576 would be important to promote healthier eating habits among students (for a review, see  
577 Kessler, 2016).

578         Participants also revealed some strategies they found to work well for them  
579 (or for people they know) when trying to reduce their amount of sugar intake. These  
580 included: reducing the amount of consumed sugar gradually, while maintaining  
581 some flexibility (i.e., allowing themselves some occasions where they could eat  
582 some sweets); choosing and/ or buying products with lower sugar content; trying to  
583 cook at home more frequently and adding less sugar to recipes; not adding sugar to  
584 coffee or tea; substituting sweet desserts by fruit; and establishing a weekly  
585 maximum intake of specific products. A recent study analyzing online content that  
586 promoted or discussed sugar reduction found over 1000 behavior change strategies,  
587 including those related to substance substitution (e.g., replacing sugar with other  
588 sweetener or choosing an option without sugar), seeking knowledge (e.g., learning  
589 to use nutritional information) and avoidance (e.g., avoiding products with sugar  
590 content) (Rodda et al., 2020). Moreover, some of the strategies regarded as  
591 acceptable and feasible by university students – such as maintaining flexibility  
592 (Sairanen et al., 2014) and home cooking (Wolfson & Bleich, 2015) - have been  
593 supported in the literature. Hence, these could be ways of reducing sugar  
594 consumption in interventions targeting this population.

595         This study allowed an in-depth consideration of perceptions, knowledge and  
596 attitudes, as well as other motivational and contextual factors contributing to sugar  
597 consumption and ways to reduce its intake. However, it was not without limitations.

598 Given its qualitative nature and small sample size, conclusions about cause and effect  
599 should be taken with caution. Our conclusion should also not be taken as representative  
600 of the views of all university students in Portugal or to reflect the views of any specific  
601 sub-group (e.g., vegetarians, young adults with obesity). Also, our sample included  
602 mostly women, who are typically more interested in nutrition and health-related topics  
603 (e.g., REF) and have greater nutritional knowledge (Lombardo et al., 2019) than men. Yet,  
604 we consider that this study has “information power” (Malterud et al., 2016), as the  
605 study aim was narrow, the sample is specific and it was possible to collect rich and  
606 clear communication data from the participants involved. Future studies with students  
607 from other universities or with young adults that are not studying at the university are  
608 needed to ensure a broader perspective and representativeness of the findings in relation  
609 to the whole age group. Moreover, based on the topics that emerged in the focus  
610 groups, large scale studies using other methods can also be implemented. For example,  
611 the overall lack of knowledge about different sugars and sugar intake guidelines may be  
612 further examined using a survey (e.g., by asking participants to rate the familiarity,  
613 valence and healthfulness of several sweeteners and sugars)

614 To conclude, this is a first qualitative study specifically investigating in-depth  
615 views of university students regarding sugar consumption, namely what might be, in  
616 their perspective, the main drivers and barriers for change. The results suggest that,  
617 from the perspective of university students, both individual factors (e.g., beliefs,  
618 attitudes, emotions) as well as contextual factors (e.g., social influences, food  
619 environment, time pressure) are relevant determinants for sugar intake. Considering the  
620 potential for change of many of the identified factors, this study offers insights that are  
621 relevant for future public health efforts aiming to reduce sugar intake.

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#### Author Contributions

629 All authors conceptualized and designed the interview schedule. CAG, IC and MP collected  
630 and analyzed the data. CAG wrote the first draft of the manuscript. All authors have  
631 reviewed, edited and approved the final manuscript.

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