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**The sugar content of children's and lunchbox beverages sold in the UK before and after the  
Soft Drink Industry Levy**

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Running title: Sugar content of children's beverages

## 27    **Abstract**

28

29    Background: Childhood obesity is associated with an increased intake of sugary soft drinks and juice  
30    drinks. The aims of this study were (1) to report the sugar and energy content in commercial fruit  
31    juice (FJ), juice drinks (JD) and smoothies (S) specifically targeted at children in the UK, (2) to  
32    identify beverages liable for the Soft Drinks Industry Levy (SDIL) and (3) to compare the amount of  
33    sugar in these beverages before and after the levy.

34    Methods: The beverages were retrieved using the online shopping tool my Supermarket, websites of  
35    nine major supermarket in the UK and manufacturers webpages. Comparisons of sugar content were  
36    taken before and after the introduction of the SDIL.

37    Results: 131 FJJDS fulfilled the inclusion criteria. The mean sugar content of all the beverages was  
38     $6.3\text{g}\pm 4.5/100\text{mL}$ . There was large variation in the sugar content from  $0.1\text{g}/100\text{mL}$  to  $15.2\text{g}/100\text{mL}$ ,  
39    with smoothies found to contain the most sugar ( $11.55\pm 1.62\text{ g/mL}$ ). The beverages were reanalysed  
40    in September 2018 to determine their eligibility for the SDIL. Of the 131 products only 7 JD were  
41    eligible for the levy. Four of these beverages had reformulated their ingredients since the initial  
42    analysis resulting in a sugar content of  $<5\text{g}/100\text{mL}$ .

43    Conclusions: The majority of the beverages targeted at children and children's lunch boxes were not  
44    eligible for the SDIL. This study suggests the necessity to adapt the SDIL to include all FJJDS aimed  
45    at children as the total sugar content of these beverages are still above the recommended quantities  
46    for this age group.

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## 54 **Introduction**

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56 Over the last 40 year's children and adolescent's obesity rate has risen from 11 million to 124 million  
57 (1). In the U.K. specifically, 9.6% of children aged 4-5 years and 20.1% of children aged 10-11-year  
58 are obese (2). Childhood obesity is known to increase the risk of becoming obese in adulthood and  
59 can lead to serious health consequences including an increased risk of developing type 2 diabetes  
60 mellitus and cardiovascular disease (3). The pathophysiology of childhood obesity is multifaceted,  
61 combining factors such as genetic susceptibility, dietary consumption and lifestyles (4). As a result  
62 of this there are growing concerns surrounding the implications of childhood obesity and  
63 Governments are required to urgently deal with what is one of the most serious health challenges of  
64 this century.

65

66 The high intake of sugar in children, especially sugar added to food products has come under scrutiny  
67 as a contributing factor to childhood obesity (5). Moreover, childhood obesity has been associated  
68 with an increased intake of sugary soft drinks and juice drinks (6). Prospective cohort studies have  
69 shown risk of developing dental caries and type 2 diabetes is associated with a greater consumption  
70 of sugar in children (7). The Scientific Advisory Committee on Nutrition (SACN) recommends that  
71 free sugar should total no more than 5% of the total daily energy intake (7). They define free sugars  
72 as the sugars added to foods and beverages by the manufacturer, cook or consumer, plus sugars  
73 naturally present in honey, syrups and fruit juice.

74

75 For a child under 3 years, plain water and milk are the recommended beverages that should be  
76 consumed (8) in order to prevent tooth decay and other possible adverse health outcome, including  
77 childhood obesity and type 2 diabetes (7). Children aged 5-11 years should continue to consume  
78 water and milk as the primary source of hydration, however fruit juice (FJ), juice drinks (JD) and  
79 smoothies (S) can be consumed in quantities of no more than a small glass (150mL) per day (9).  
80 However, in the latest National Diet and Nutrition Survey (NDNS) (10) fruit juice contributed 12%

81 of free sugar intake in children aged 1.5-3 years, 11% in 4 to 10 year olds and 10% in 11 to 18  
82 years. In addition, previous data from the National Diet and Nutrition Survey 2008–2011, showed  
83 that the volume of fruit juice drink (which may or may not include sugar) intake in 4-8 year olds  
84 contributed to 241.3mL/day intake compared to a 240.5mL/day intake of milk. In 9-13 year olds,  
85 this was 242.8mL/day of fruit drink compared to 184.9mL/ day of milk (11). This highlights the  
86 large consumption rate of these types of beverages in UK children's diets and potential contribution  
87 to free sugar intake.

88

89 On the 6th of April 2018 the U.K. government implemented the Soft Drinks Industry Levy (SDIL).  
90 The aim of this levy is to decrease the rates of obesity with the levy forming part of the UK  
91 Government's 2016 "Childhood obesity: A plan for action" document (12, 13). A beverage is liable  
92 for the levy if it meets the following conditions: a) it has had sugar added during production, or  
93 anything (other than fruit juice, vegetable juice and milk) that contains sugar, such as honey; b) it  
94 contains at least 5 g of sugar per 100 mL in its ready to drink or diluted form c) it's either ready to  
95 drink, or to be drunk it must be diluted with water, mixed with crushed ice or processed to make  
96 crushed ice, mixed with carbon dioxide, or a combination of these d) it's bottled, canned or otherwise  
97 packaged so it's ready to drink; e) it has a content of 1.2% alcohol by volume (ABV) or less.  
98 Beverages are not eligible for the levy if they are made with fruit juice or vegetable juice and don't  
99 have any other added liable sugar (14). The food industry has been encouraged to reformulate  
100 beverages in order to reduce the levy that will be applied to them (13).

101

102 With these facts in mind, the present study had three aims. (i): To provide an updated and  
103 comprehensive review of the sugar and energy content in commercial FJDS beverages that were  
104 specifically targeted at children in the UK and (ii) To identify the beverages that are liable for the  
105 SDIL and (iii) compare the amount of sugar in these beverages before and after the levy was  
106 implemented.

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## 110 **Method**

111

112 The methodological design of the study is divided into two parts, before and after the SDIL. The first  
113 part is an update on the study by Boulton *et al* (15), in which the aim was to record and evaluate the  
114 sugars content of children's FJJDs. The second part is to compare the sugar content of these  
115 beverages before and after the SDIL was introduced in April 2018.

116

### 117 *Beverage Evaluation*

118

119 The beverages were retrieved using the online shopping tool my Supermarket, as well as websites of  
120 nine major supermarket in the UK, including; Tesco, Asda, Morrisons, Sainsbury, Waitrose, Ocado,  
121 Aldi, Marks & Spencer (M&S) and Lidl, during the period of December 2017 and February 2018.  
122 This was done by accessing the "kids and lunchbox beverages" or equivalent grocery divisions  
123 available on the websites of supermarkets. Both supermarket-own brand and branded products were  
124 included. For FJJDs that did not present in these specific divisions, the presence of children appealing  
125 graphics, slogans or strap lines that were tailored towards children - such as "ideal for kid's  
126 lunchboxes", were used to determine whether the beverages were suitable to be included in this study.  
127 Only beverages that specifically targeted at children were included in the analysis.

128

129 Descriptive data, including the brand name, product description, type of drink (FJ/JD/S),  
130 recommended age group, serving size, ingredients and price were recorded from super market  
131 webpage, official manufacturer websites or in-store samples. In addition, nutritional information,  
132 including the energy (kcal/100mL), protein (g/100mL), carbohydrate (g/100mL), sugar (g/100mL),  
133 fat (g/100mL), saturated fat (g/100mL), salt (g/100mL) and fibre (g/100mL) content were also

134 collated into a database. Products that were offered in different packaging sizes were only recorded  
135 once.

136

137 Sweetened water that contained zero content of fruit juice, cordial, sports drinks and flavoured iced  
138 teas were not included in this study. Cordial beverages were excluded from this analysis as dilution  
139 of these beverages is often subjective in nature as individuals may dilute to their taste instead of the  
140 recommended guidelines (15). As a result, the sugar and energy content in each serving may vary;  
141 this would cause difficulty in comparing these products to the baseline FJJDs. Additionally cordial  
142 beverages were not seen to be marketed solely at children and were not marketed as “kids and  
143 lunchbox beverages”’s and hence did not meet our inclusion criteria for this reason also.

144

145 The classification of juices was completed in accordance with the guidelines published by the Food  
146 Standards Agency (2007) and the British Soft Drinks Association (2016) (16) in which Fruit Juice  
147 (FJ) is obtained “directly from fruit”. Fruit Juice from concentrate (FJC) “is juice which has been  
148 concentrated and returned to its original state by the addition of water”. Fruit Juice non-concentrate  
149 (FJNC) “refers to products just obtained directly from fruit and not treated by reconstitution”. With  
150 regards to Smoothies (S) there is no legal definition of a smoothie and no standard method of  
151 manufacture, however, fruit smoothies usually contain crushed fruit, purees and fruit juice. On the  
152 other hand, Juice Drinks (JD) are flavoured beverages that contain between 1% to 99% juices, with  
153 the addition of the presence of additives, such as added sugar (16). Although product sizes varied,  
154 nutritional data were compared at a standardised 100mL size, to enable comparison between products.

155

156 After the SDIL came into effect in April 2018, the original database was updated in September 2018.  
157 From the samples that were collected, those eligible for the levy were identified. Only JD beverages  
158 were affected by the levy as they are the only group that met the required conditions (16).  
159 Subsequently, the database was revised and the nutritional information before and after the levy was



160 compared to identify any changes in the amount of sugar they contain per 100mL and the addition of  
161 sugar. A Pearson's correlation was conducted to assess the correlation between energy and sugar  
162 content, as well as between sugar content and product prices.

163

## 164 **Results**

165

166 A total of 131 FJJDS samples fulfilled the inclusion criteria, thus, were included in the dataset.

167

### 168 *Before the Soft Drinks Industry Levy*

169

170 All 131 beverages identified contained sugar, in which the mean sugar content was  $6.3 \pm 4.5$  g/100mL.

171 The relatively large standard deviation indicates that the sugar content varies greatly between

172 products with values ranging from 0.1g/100mL to 15.2g/100mL. The average sugar content in the

173 FJC category was  $10.2 \pm 1.19$  g/100mL (n=25). The average sugar content of 100% fruit juice (FJNC)

174 was  $9.5 \pm 0.83$  g/100mL (n=9). On average, JD contained  $3.3 \pm 3.37$  of sugar per 100mL (n=77) and

175 smoothies contained the most sugar on average  $11.6 \pm 1.5$  g/100mL (n=20) (Table 1). Forty products

176 of the 131 FJJDS that were analysed contained at least 19g/100mL of sugar. According to the Public

177 Health England this is the maximum daily sugar allowance for a 4 to 6-year-old children (8).

178 Furthermore, 81 of the 131 products contained at least 9.5g/100mL of sugar, which represents half of

179 the daily sugar recommendations for this age group (17).

180

181 The mean energy content of the 131 FJJDS analysed was  $29.2 \pm 21.3$  kcal/100mL. The energy content

182 of the FJC was reported as  $45.9 \pm 3.1$  kcal/100mL, the FJNC as  $44.6 \pm 4.1$  kcal/100mL, the JD contained

183  $14.5 \pm 13.8$  kcal/100mL and Smoothies contained  $57.8 \pm 11.3$  kcal/100mL. The results showed that

184 there was a strong positive correlation ( $\rho = 0.98$ ,  $p < 0.001$ ) between the sugar content and the energy

185 content of the beverages, such that FJJDS that contain a higher sugar content would also provide more

186 calories than FJJDS with a lower sugar content.

187

188 The price of beverages was also examined. The prices between beverages varied by as much as 16-  
189 fold. On average, commercial children's FJDS were sold at £0.23±0.18/100mL, in which smoothies  
190 were found to be the most expensive beverage type among the FJDS series, with an average price of  
191 £0.54± 0.18/100mL. Furthermore, a positive correlation ( $r=0.55$ ,  $p<0.05$ ) was also been found  
192 between sugar content and beverage prices, indicating that the more expensive or premium products  
193 contain more sugar and energy than the cheaper products.

194

195 *After the Soft Drinks Industry Levy*

196

197 The SDIL was introduced in April 2018. In September 2018 all 131 products were reanalysed to  
198 determine their eligibility to the SDIL guidelines. Considering the classification of beverages given  
199 by the British Soft Drinks Association (16) and the conditions that a drink must meet to be eligible,  
200 JD are the only category of beverage that could be eligible for the levy. After reanalysis, 7 JD were  
201 eligible for taxation as they contained more than 5g/100mL of sugar and added sugar in their  
202 ingredients (Table 2). Since the Levy, four of these samples have reformulated their ingredients  
203 resulting in a sugar content of <5g/100mL. The other three had not been reformulated as of October  
204 2018. In addition, 3 JD that were not eligible for the levy were also reformulated to reduce their sugar  
205 intake. However the amount of sugar they contained even after reformulation was still over 5g/100mL  
206 (Table 3).

207

208

## 209 **Discussion**

210

211 The aims of the present study were to report the sugar and energy content in commercial FJDS  
212 beverages that were specifically targeted at children in the UK. It also aimed to identify the beverage  
213 that are liable for the SDIL and compare the amount of sugar they contained before and after the levy.

214 An important finding was that most of the beverages targeted at children and children's lunch boxes  
215 were not eligible for the SDIL including the grouping of smoothies which contain the highest amount  
216 of free sugar.

217

218 *Before the Soft Drinks Industry Levy*

219

220 The World Health Organisation has stated that healthy food environments need to be created and  
221 protected for children (1). In the UK, reducing dietary sugar intakes has been highlighted as potential  
222 means for doing this (12). In the current study, forty beverages of the 131 FJJDS contained above the  
223 maximum daily sugar allowance for a 4 to 6-year-old children (8) and 81 beverages contained at half  
224 of the daily sugar recommendations for this age group (17). This agrees with the finding in previous  
225 literature (15) in which the authors found 64% of the products examined contained  $\geq 9.5\text{g}$  of sugar,  
226 suggesting that the sugar content in commercial children FJJDS has not changed significantly in the  
227 past 3 years despite the ongoing scrutiny over the sugar content in FJJDS.

228

229 Moreover, the majority of beverages examined in the present study were packaged in a 200mL size  
230 and were advertised as "perfect for lunchboxes", implicating that the beverages are highly likely to  
231 be consumed by the children in one serving, hence greatly increasing the risk of excess consumption  
232 of sugar and energy. One possible factor that might have fuelled the consumption of FJJDS is the  
233 public perception of it as a healthier, lower sugar alternative to soft drinks (18,19). In a survey  
234 conducted in 2014 asking for the perception of the public on the sugar content in beverages, the sugar  
235 content in soft drinks was overestimated by 12%, in comparison to that in FJJDS, which has been  
236 underestimated by close to 50% (18), suggesting that consumers were not fully aware of the actual  
237 sugar content in these products. Alongside this, manufacturers have been associating FJ consumption  
238 and achieving the "5-a-day" fruit and vegetable intake recommendation in their marketing strategies  
239 (19). However, a recent market report showing that the general public might not be aware that only a

240 150mL portion of FJ counts as one of the “5-a-day”. Less than a third of respondents were aware that  
241 daily consumption of FJ should be limited to 150mL (19). In fact, of the 131 products surveyed in the  
242 current study, only 8 were in a  $\leq 150\text{mL}$  package, suggesting that it is most likely that consumers,  
243 children in particular, will exceed the maximum recommended daily intake of FJ, and hence be at  
244 risk of excessive intake of sugar.

245

#### 246 *After the Soft Drinks Industry Levy*

247

248 The UK is not the only country that has established a tax or levy on sugar-sweetened beverages in an  
249 attempt to decrease the obesity prevalence. Similar levies have been executed in six U.S cities and 19  
250 countries including Mexico, France, Chile, Brazil, and legislated in South Africa (20). In Mexico  
251 there was a 12% reduction per capita of sugar-sweetened beverage purchases after the first year which  
252 was followed by a decrease of 9.7% in the second year (20).

253 As it was shown in the results, many of the beverages that are not eligible for the sugar tax, contain a  
254 high amount of sugar and there is no incentive for these to be reformulated. Smoothies contained the  
255 highest sugar content of all the drink categories surveyed, however they are often associated with  
256 being a healthier alternative to soft drinks (21). The current research does indicate that although the  
257 Levy was introduced in an attempt to reduce sugar intake in children as part of the Childhood Obesity  
258 Plan (12) it may not be serving its purpose as it is not targeting products that are aimed at children.

259

260 The sugar tax/levy has the potential to reduce the amount of sugar sweetened beverages being  
261 consumed, nevertheless the application of other health promotion strategies such as education  
262 campaigns, easy-to-understand food labelling, food regulations, subsidies for healthier foods (20) are  
263 also needed to help people make informed decisions. The study by Moran *et al* (21) confirms that  
264 parents believe that juice drinks and other beverages are healthier than other soft drinks. This issue is  
265 probably due to these drinks being advertised as healthier alternatives, which could help influence

parent's buying decisions. Previous literature has reported that both soft drinks and FJJDS are positively correlated with risk of being overweight or obese (3, 6), suggesting that the sugar and energy in FJ could be equally as obesogenic as the sugar-sweetened beverages that are currently being taxed.

## *Conclusion*

The current study indicates that the sugar content of FJJDS remains high. These beverages make a large contribution to the sugar intake in children yet the majority of the them are not eligible for the SDIL. There appears to be little incentive to the food industry to reformulate these beverages and as such the changes to the sugar content before and after the introduction of the SDIL was minimal.

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**Authorship:** SEH and MEC developed the research question, BTYC and CPI collected the data. All authors contributed to the analysis of the findings of the manuscript and wrote the manuscript. All authors approved the final submission.

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