

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

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22 Running title: Sugar content of children's beverages
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27 **Abstract**

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29 Background: Childhood obesity is associated with an increased intake of sugary soft drinks and
30 juice drinks. The aims of this study were (1) to report the sugar and energy content in commercial
31 fruit juice (FJ), juice drinks (JD) and smoothies (S) specifically targeted at children in the UK, (2)
32 to identify beverages liable for the Soft Drinks Industry Levy (SDIL) and (3) to compare the
33 amount of 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
36 were 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
45 aimed at children as the total sugar content of these beverages are still above the recommended
46 quantities 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
57 million (1). In the U.K. specifically, 9.6% of children aged 4-5 years and 20.1% of children aged
58 10-11-year are obese (2). Childhood obesity is known to increase the risk of becoming obese in
59 adulthood and can lead to serious health consequences including an increased risk of developing
60 type 2 diabetes mellitus and cardiovascular disease (3). The pathophysiology of childhood obesity is
61 multifaceted, combining factors such as genetic susceptibility, dietary consumption and lifestyles
62 (4). As a result of this there are growing concerns surrounding the implications of childhood obesity
63 and Governments are required to urgently deal with what is one of the most serious health
64 challenges of this century.

65

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

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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
97 otherwise packaged so it’s ready to drink; e) it has a content of 1.2% alcohol by volume (ABV) or
98 less. Beverages are not eligible for the levy if they are made with fruit juice or vegetable juice and
99 don’t 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).

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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 FJJDS 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**

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

116

117 *Beverage Evaluation*

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

129

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

134 fat (g/100mL), saturated fat (g/100mL), salt (g/100mL) and fibre (g/100mL) content were also
135 collated into a database. Products that were offered in different packaging sizes were only recorded
136 once.

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

145

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

157

158 After the SDIL came into effect in April 2018, the original database was updated in September
159 2018. From the samples that were collected, those eligible for the levy were identified. Only JD

160 beverages were affected by the levy as they are the only group that met the required conditions (16).
161 Subsequently, the database was revised and the nutritional information before and after the levy was
162 compared to identify any changes in the amount of sugar they contain per 100mL and the addition
163 of sugar. A Pearson's correlation was conducted to assess the correlation between energy and sugar
164 content, as well as between sugar content and product prices.

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166 **Results**

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

169

170 *Before the Soft Drinks Industry Levy*

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172 All 131 beverages identified contained sugar, in which the mean sugar content was
173 6.3 ± 4.5 g/100mL. The relatively large standard deviation indicates that the sugar content varies
174 greatly between products with values ranging from 0.1g/100mL to 15.2g/100mL. The average sugar
175 content in the FJC category was 10.2 ± 1.19 g/100mL (n=25). The average sugar content of 100%
176 fruit juice (FJNC) was 9.5 ± 0.83 g/100mL (n=9). On average, JD contained 3.3 ± 3.37 of sugar per
177 100mL (n=77) and smoothies contained the most sugar on average 11.6 ± 1.5 g/100mL (n=20) (Table
178 1). Forty products of the 131 FJJDS that were analysed contained at least 19g/100mL of sugar.
179 According to the Public Health England this is the maximum daily sugar allowance for a 4 to 6-
180 year-old children (8). Furthermore, 81 of the 131 products contained at least 9.5g/100mL of sugar,
181 which represents half of the daily sugar recommendations for this age group (17).

182

183 The mean energy content of the 131 FJJDS analysed was 29.2 ± 21.3 kcal/100mL. The energy
184 content of the FJC was reported as 45.9 ± 3.1 kcal/100mL, the FJNC as 44.6 ± 4.1 kcal/100mL, the JD
185 contained 14.5 ± 13.8 kcal/100mL and Smoothies contained 57.8 ± 11.3 kcal/100mL. The results
186 showed that there was a strong positive correlation ($\rho = 0.98$, $p < 0.001$) between the sugar content

187 and the energy content of the beverages, such that FJJDS that contain a higher sugar content would
188 also provide more calories than FJJDS with a lower sugar content.

189

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

196

197 *After the Soft Drinks Industry Levy*

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199 The SDIL was introduced in April 2018. In September 2018 all 131 products were reanalysed to
200 determine their eligibility to the SDIL guidelines. Considering the classification of beverages given
201 by the British Soft Drinks Association (16) and the conditions that a drink must meet to be eligible,
202 JD are the only category of beverage that could be eligible for the levy. After reanalysis, 7 JD were
203 eligible for taxation as they contained more than 5g/100mL of sugar and added sugar in their
204 ingredients (Table 2). Since the Levy, four of these samples have reformulated their ingredients
205 resulting in a sugar content of <5g/100mL. The other three had not been reformulated as of October
206 2018. In addition, 3 JD that were not eligible for the levy were also reformulated to reduce their
207 sugar intake. However the amount of sugar they contained even after reformulation was still over
208 5g/100mL (Table 3).

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210

211 **Discussion**

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213 The aims of the present study were to report the sugar and energy content in commercial FJJDS
214 beverages that were specifically targeted at children in the UK. It also aimed to identify the
215 beverage that are liable for the SDIL and compare the amount of sugar they contained before and
216 after the levy. An important finding was that most of the beverages targeted at children and
217 children's lunch boxes were not eligible for the SDIL including the grouping of smoothies which
218 contain the highest amount of free sugar.

219

220 *Before the Soft Drinks Industry Levy*

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

231

232 Moreover, the majority of beverages examined in the present study were packaged in a 200mL size
233 and were advertised as "perfect for lunchboxes", implicating that the beverages are highly likely to
234 be consumed by the children in one serving, hence greatly increasing the risk of excess
235 consumption of sugar and energy. One possible factor that might have fuelled the consumption of
236 FJJDS is the public perception of it as a healthier, lower sugar alternative to soft drinks (18,19). In a
237 survey conducted in 2014 asking for the perception of the public on the sugar content in beverages,
238 the sugar content in soft drinks was overestimated by 12%, in comparison to that in FJJDS, which

239 has been underestimated by close to 50% (18), suggesting that consumers were not fully aware of
240 the actual sugar content in these products. Alongside this, manufacturers have been associating FJ
241 consumption and achieving the “5-a-day” fruit and vegetable intake recommendation in their
242 marketing strategies (19). However, a recent market report showing that the general public might
243 not be aware that only a 150mL portion of FJ counts as one of the “5-a-day”. Less than a third of
244 respondents were aware that daily consumption of FJ should be limited to 150mL (19). In fact, of
245 the 131 products surveyed in the current study, only 8 were in a ≤ 150 mL package, suggesting that it
246 is most likely that consumers, children in particular, will exceed the maximum recommended daily
247 intake of FJ, and hence be at risk of excessive intake of sugar.

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249 *After the Soft Drinks Industry Levy*

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

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

263

264 The sugar tax/levy has the potential to reduce the amount of sugar sweetened beverages being
265 consumed, nevertheless the application of other health promotion strategies such as education
266 campaigns, easy-to-understand food labelling, food regulations, subsidies for healthier foods (20)
267 are also needed to help people make informed decisions. The study by Moran *et al* (21) confirms
268 that parents believe that juice drinks and other beverages are healthier than other soft drinks. This
269 issue is probably due to these drinks being advertised as healthier alternatives, which could help
270 influence parent's buying decisions. Previous literature has reported that both soft drinks and FJJDS
271 are positively correlated with risk of being overweight or obese (3, 6), suggesting that the sugar and
272 energy in FJ could be equally as obesogenic as the sugar-sweetened beverages that are currently
273 being taxed.

274

275 *Conclusion*

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

281

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284

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286 All authors contributed to the analysis of the findings of the manuscript and wrote the manuscript.

287 All authors approved the final submission.

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