



# Sugar and Health



Sugars can be added to food and drinks or occur naturally in fruit, vegetables and milk. A high sugar diet increases the risk of tooth decay and weight gain, and high consumption of sugar-sweetened drinks is associated with type 2 diabetes. This paper describes trends in sugar consumption in the UK, the public health implications and outlines policy options.

## Background

There is a wide body of academic research on the relationship between sugar consumption and health, notably dental health<sup>1</sup> as well as possible associations with obesity, diabetes and cardio-vascular conditions. This note describes consumption trends, evidence of the effect of sugar on health and options to reduce consumption through health education, voluntary action by food manufacturers and retailers (reformulating products, changing retail environments) and regulation (restricting advertising to children, limiting purchasing opportunities, modifying food labelling and taxation).

## Sugar Consumption

For all age groups, government advice since 1991 is that no more than 10% of a person's average total energy intake should come from non-milk extrinsic sugars (NMES, Box 1), equivalent to 12 teaspoons of table sugar.<sup>2</sup> People participating in dietary surveys under-report how much they eat<sup>3,4</sup> by up to 25%<sup>5</sup>, particularly for foods high in fat and sugar.<sup>6</sup> This bias is even greater for those who are overweight or obese. The most comprehensive data about the UK population's diet is from Public Health England's National Diet and Nutrition Survey (2008-2012)<sup>7</sup> which found that all age groups consume well in excess of the 10% guideline. Intake of sugar by adults tended to be higher in groups with the lowest incomes.<sup>8</sup> Children consume the

## Overview

- All age groups consume more sugar than the Government's recommended daily limit (10% of daily energy intake).
- There is concern about the negative impact of this level of consumption on public health, notably tooth decay, obesity and type 2 diabetes.
- Government policy to improve diet and health includes voluntary industry pledges to reduce calories in products (including lowering sugar content), provide better labelling, supported by education campaigns to help people to make healthier choices.
- The food industry is supportive of, and engaged with the Responsibility Deal. However this policy has been criticised as ineffective, with calls for regulation instead.

most NMES. Intake for 4-10 year olds was 14.7% of total energy, for 11-18 year olds was 15.4% and for adults aged 19-64 was 11.5%. The main sources of NMES in the diet were:

- for children aged 4-10, soft drinks and fruit juice (30%) and cereals and cereal products (such as cake, pastries and biscuits) (29%)
- for children aged 11-18, most comes from soft drinks and fruit juice (40%).
- for adults (19-64) table sugar, preserves and confectionery contribute most (26%), non-alcoholic drinks (25%), and cereals/cereal products (21%).
- for over 65s, most comes from cereals/cereal products (29%) and sugar, preserves and confectionery (26%).<sup>7</sup>

The main sources of dietary sugar come from sugars added to processed foods such as soft drinks, fruit juice, cereals, biscuits, cakes, pastries, preserves and confectionery. For example there are 8.5 teaspoons of sugar in a 330ml can of cola,<sup>9</sup> while most cereals marketed to appeal to children are high in sugar.<sup>10</sup> Fruit juices (including 100% fruit juices) are also a significant source of sugar, accounting for an estimated 10-14% of NMES consumed by children.<sup>7</sup> Some health groups are calling for fruit juices to be removed from the recommended five portions of fruit and vegetable a day list, because of their high sugar content.<sup>11</sup>

**Box 1. Glossary of Terms Used to Describe Sugars**

Monosaccharides are sugars composed from one unit, such as fructose or glucose. Disaccharides are two monosaccharides joined together, such as sucrose (table sugar, comprising glucose and fructose) or lactose (in milk, comprising glucose and galactose).

- **Intrinsic Sugars** are found within cell structures. The main sources of intrinsic sugars are whole fruits and vegetables.
- **Extrinsic sugars** are sugars not contained in the cell structure of foods (such as those extracted from sugarcane or sugar beet). It describes all sugars added to food, sugar in fruit juice, table sugar and honey. It also refers to sugars in milk.
- **Non-Milk Extrinsic Sugars (NMES)** are all extrinsic sugars not from milk. This is a term used exclusively in the UK.
- **Free Sugars** is a term used by the World Health Organisation to describe "all monosaccharides and disaccharides added to foods by the manufacturer, cook, or consumer, plus sugars naturally present in honey, syrups, and fruit juices."<sup>12</sup>

**Evidence on Sugar and Health**

This section outlines the main areas of concern to policymakers, and draws on recent evidence reviews conducted by the scientific committees advising the World Health Organisation (WHO) and the Department of Health (DH). The evidence linking sugar consumption to dental caries and weight gain is clear, but for other conditions such as type 2 diabetes and cardiovascular disease the evidence is less robust or absent.

**Dental Caries**

Dental caries is one of the most common reasons for children to be hospitalised in England, with 46,520 admissions to hospital in 2013-14.<sup>13</sup> A recent study in England found 12% of three year olds<sup>14</sup> and 27% of five year olds<sup>15</sup> had tooth decay. Adults tend to have higher incidence of caries (UK 31%)<sup>16</sup> because of cumulative effects over time. Research shows that deprivation is strongly associated with a risk for developing dental caries.<sup>17</sup> It is estimated that poor dental health costs the NHS £3.4 billion a year.<sup>8</sup> There is a strong association between dental caries and the daily total amount of sugar consumed (whether in food or drinks) but there is debate about the strength of the association with frequency of consumption. For sugar-containing drinks, both the amount and frequency of consumption are associated with caries. A systematic review commissioned by WHO found that the incidence of caries is lower when sugar intake is less than 10% of total energy intake and that there may be benefit in limiting sugars to less than 5% to further minimise the risk of caries throughout life.<sup>18</sup> A recent academic study recommended that no more than 5% of daily calories should come from sugar, to reduce caries.<sup>1</sup>

**Obesity and Overweight**

In England in 2012, a quarter of adults were obese, with a further 42% of men and 32% of women overweight. For children, 14% were obese, with approximately 15% overweight.<sup>19</sup> The estimated annual cost to the NHS is £5bn.<sup>20</sup> Although exercise is an important factor, excess calorie intake is the main cause.<sup>21</sup> Being overweight or obese is a risk factor for many serious and chronic health

concerns including type 2 diabetes, some cancers, coronary heart disease, respiratory disease and fatty liver disease.<sup>22</sup>

The evidence review that informed the WHO's dietary sugar guideline<sup>23</sup> concluded that increased or decreased intake of sugar is associated with weight gain and loss respectively.<sup>24</sup>

The reason is that diets high in sugars are more calorific than those lower in sugars<sup>25</sup> and excess calorie intake is associated with weight gain. Trials using isoenergetic diets (diets that contain the same number of calories) showed that switching sugars for other carbohydrates made no difference to body weight.<sup>24</sup> There is some evidence from randomised control trials that sugar-sweetened drinks are associated with weight gain in children and adults (Box 2). Overall these studies support approaches to reduce consumption of sugar-sweetened drinks. This is particularly relevant for children since these products account for at least 40% of the sugar they consume.

**Type 2 Diabetes**

Type 2 diabetes occurs when the body does not produce enough insulin to maintain normal blood sugar levels. It is aggravated by consuming excess calories, particularly when body tissues become resistant to insulin, as occurs in obesity.<sup>26</sup> Diabetes affects 6% of the UK population, 90% of whom have type 2 diabetes. It cost the NHS an estimated £8.8bn in 2011 and is predicted to account for 17% of the NHS budget by 2024.<sup>27</sup> Genetic predisposition and external factors such as deprivation increase the risk of type 2 diabetes, but obesity accounts for most of the risk (80-85%).<sup>28</sup> There is some evidence that excessive sugar consumption increases the risk of type 2 diabetes.<sup>29,30,31,32</sup> However, excessive consumption of sugar-sweetened drinks (Box 2) is a significant risk factor for type 2 diabetes and a significant source of calories which can lead to weight gain.<sup>33,29</sup> It is not yet clear whether sugar causes type 2 diabetes through a mechanism other than weight gain.

There are few studies on the effect of individual sugars such as sucrose, fructose, glucose or lactose. Fructose, found with glucose in most sugar-sweetened drinks and confectionery, has been the focus of much recent attention because it accelerates the metabolism of dietary glucose in the liver, and is implicated in fatty liver disease and insulin resistance.<sup>34</sup> However, a draft report by the Government's Scientific Advisory Committee on Nutrition (SACN) considers that there is insufficient evidence to link fructose to adverse health outcomes independent of any effects related to total sugars in the diet.<sup>35</sup>

**Cardiovascular Conditions**

Diseases of the heart and circulation (such as coronary heart disease, abnormal blood pressure and stroke) are the second highest cause of death in the UK, accounting for 28% of deaths in 2013.<sup>36</sup> In 2009, cardiovascular disease cost the NHS £8.6bn.<sup>37</sup> The main risk for cardiovascular disease is obesity, due to excess calorie intake.<sup>38</sup> Some recent evidence suggests that sugar intake may influence cardio-metabolic risk factors (high blood pressure and blood lipids [fats]).<sup>39</sup>

**Box 2. Sugar-Sweetened Drinks**

Sugar-sweetened drinks main components are water and sugar. They have been associated with a higher risk of weight gain compared to similarly calorific solid food,<sup>40</sup> partly because they do not make a person feel full.<sup>41</sup> Evidence indicates a link between habitual, excess consumption and type 2 diabetes<sup>33</sup> and weight gain. A large study of European adults showed that there was a 22% increase in diabetes incidence associated with habitual consumption of one daily serving of sugar-sweetened drinks.<sup>42</sup> Since sugar-sweetened drinks contribute a significant amount of sugar to children's diet,<sup>7</sup> a reduction in their consumption is viewed as a significant step towards lowering intake.

**Scientific Advice to Government**

In 2008, DH and the Food Standards Agency asked SACN to review the scientific evidence on health and carbohydrates, including sugars. Part of the review's remit is to determine the health outcomes associated with a diet high in sugar and the relationship between the degree of risk and the amount of sugar consumed. The report will be published later in 2015, but a draft version was published for consultation in 2014. It contained interim recommendations to revise down the daily average recommended sugar intake from the current 10% guideline to 5%, equivalent to six teaspoons of sugar a day (96 calories).<sup>43</sup> This is similar to the 2015 WHO guideline.<sup>44</sup> If adopted by the Government, such recommendations could see public health messages go further to advise people to limit their consumption of table sugar and high sugar foods (such as cereals, biscuits and confectionery) and to minimise consumption (amount and frequency) of fruit juice and sugar-sweetened drinks.

**Policy Options**

This section describes a range of policy options to reduce sugar consumption, often within wider strategies to improve overall diet. DH and Public Health England (PHE) have several policies intended to improve health by encouraging lifestyle changes, through improved diet and increased physical activity. PHE published a specific strategy to reduce sugar consumption in 2014.<sup>8</sup>

**Public Health Information Campaigns**

Health education is commonly used to inform the public about how to lead a healthy lifestyle. The Government's Change4Life campaign<sup>45</sup> uses TV, radio, social media and direct marketing to encourage individuals to eat at least five portions of fruit and vegetables a day, substitute unhealthy foods with healthier alternatives, drink less alcohol and exercise more. In January 2015, a phase of the campaign specifically focussed on sugar consumption began. The Sugar Swaps initiative encourages families to focus on simple daily substitutions such as switching sugary breakfast cereals for plainer options, ice cream for lower fat, lower sugar yoghurt and sugar-sweetened drinks for sugar-free or no added sugar alternatives. Interim data from a study analysing the impact of Sugar Swaps on 24 families' diets found that sugar consumption reduced by the equivalent of 47 teaspoons per family, per day.<sup>46</sup> Further research will examine whether this behaviour is sustained in the long-term. However, despite public health information campaigns, obesity continues to rise,<sup>47</sup> with policymakers

seeking other approaches to reduce people's total calorie intake (including those from sugar).

**The Public Health Responsibility Deal**

The Public Health Responsibility Deal<sup>48</sup> (RD) involves voluntary participation from food manufacturers and retailers. One area is a calorie reduction pledge, achieved by reformulation, reducing portion size and developing lower calorie options (see below). Reducing the sugar content of high sugar foods partly overcomes conditioned shopping and dietary behaviour that is difficult to change, and perceptions that healthier options have poorer flavour.<sup>49,50</sup> This approach is particularly relevant for those on lower incomes who tend to eat more sugar and have poorer diet overall,<sup>3</sup> perceive healthy eating as being more expensive and are sensitive to price promotions.

Industry is supportive of and engaged with the RD and has reduced the sugar content in some products. However the initiative has been criticised by public health bodies and campaign groups who argue that it is ineffective, lacks ambition and has vague timescales for meeting targets.<sup>51,52,53</sup> For example, a recent analysis of the sugar content of breakfast cereals marketed to appeal to children shows marginal reductions (and in some cases gains) in sugar content since 2012.<sup>54</sup> Other criticisms are that it does not restrict marketing to children or include responsible price promotions. The consumer group Which? notes that the RD lacks incentives for food companies to enact strong positive change and suggests that more focus should be given to reducing saturated fat, sugar and calories. The Which? report also calls for price promotions for healthier foods and restrictions on marketing to children.<sup>53</sup> The campaign group Action on Sugar has called for a 40% reduction of sugar in food and drinks by 2020, a ban on advertising unhealthy food and drinks to under 16s, and a duty on sugary drinks.<sup>55</sup>

*Product Reformulation and Reducing Portion Size*

Reformulation involves reducing the sugar added to a product or substituting it with a lower calorie alternative (Box 3). This is simple for soft drinks consisting mainly of carbonated water and sweeteners, but can be less straightforward for solid foods. Sugar has the same calorific value as any other carbohydrate (such as starch), so replacing sugar with starch does not reduce calorie content. Using low calorie alternatives replicates the sweetness of sugar, and so does not give consumers the opportunity to adjust to a less sweet-tasting diet.<sup>56</sup> Manufacturers argue that sugar reformulation in foods is challenging (Box 3). However, reformulating foods has contributed to reducing average salt intake by 15% since 2006, through voluntary action by manufacturers and retailers. Some consider this to have been a major contributor to the fall in blood pressure in England between 2003-2011.<sup>57</sup> Portion size is another factor that influences total calories consumed: more calories are consumed when a large portion is presented compared to a smaller one<sup>58,59</sup> and serving smaller portions has the opposite effect.<sup>60,61</sup> As part of the RD, some manufacturers are voluntarily reducing the overall calorie content of some products. For example, some confectionery manufacturers

**Box 3. Sugar Substitutes**

Sugar substitutes may be made from natural or artificial sources, and include polyols, aspartame, steviol extracts and saccharin. Some are 200 times sweeter than sugar and require little to be used. They do not cause dental caries because oral bacteria cannot break them down. Sugar substitutes have been used in diet drinks and chewing gum for years and have been shown to be safe.<sup>62</sup> There has been less adoption of substitutes into food products because they do not mimic the effects of sugar with respect to texture, structure and colour of food and extending shelf-life. Some substitutes (polyols) have laxative effects at high doses, further restricting their use.

limit the calorie content of chocolate bars to less than 250 calories.<sup>63</sup> Some found that this could not be done by reformulation alone and have reduced portions to meet targets. A combination of reformulation and changing product size may be more effective in making less energy dense foods.<sup>64</sup>

**Food and Drink Labelling**

Food labelling is an important source of nutrition information for consumers. EU regulation mandates back-of-pack labels listing all food and drink ingredients, including sugar content.<sup>65</sup> As part of the RD, voluntary front-of-pack labelling was introduced in 2013.<sup>66</sup> It is intended to give consumers clear information about the level of sugar (plus energy, fat and salt) in a product using red, amber and green colour coding (traffic lights) and reference intakes (an indication of how much energy or nutrient an average adult needs).<sup>67</sup>

Most big supermarkets have signed the pledge on labelling, as have some producers. However, traffic light labelling is not used consistently by manufacturers.<sup>68,69</sup> Research to assess consumers' use of front-of-pack labelling showed that 27% of people used the labels when buying food. Understanding the health inferences of the labels ranged from 70-90% but they were mainly used by people with an interest in healthy eating. Lack of use was put down to habitual food purchasing and perceptions that healthy foods are less tasty.<sup>70</sup> Health campaigners have suggested that drinks high in sugar should carry specific health warnings, about the link with type 2 diabetes and weight gain.

**Food Options in Public Sector Facilities**

Drinks with added sugar and confectionery are banned in school meals and vending machines in schools across the UK.<sup>71,72</sup> The Welsh Government imposed a similar ban on hospital vending in 2012.<sup>73</sup> There has been much criticism of the wide availability of such products sold in public sector facilities such as leisure centres and hospitals. The Academy of Medical Royal Colleges proposed a ban on the sale of "junk food and junk drinks" in hospitals in England.<sup>74</sup>

**Retail Environment**

The presentation of products to consumers in shops directly influences what items they buy, especially where children are involved.<sup>75</sup> For example, one UK study showed carbonated drinks placed on end-of-aisle promotion increased sales by 51%.<sup>76</sup> Regulation could include restrictions on the positioning of high-sugar items and their

removal from special displays.<sup>77</sup> There has been little research on the effect such changes would have or the mechanisms of implementation. The British Retail Consortium, which represents many UK supermarkets, states that it does not "wholly share the opinion that environment is driving obesity".<sup>78</sup> In response to parental concern some retailers have removed confectionery from check-out areas.<sup>79</sup> However, some convenience stores still market high sugar foods at check-outs<sup>80</sup> and many retailers display them at check-outs during seasonal promotions.

**Regulation of Advertising**

Advertising unhealthy foods including those high in sugar during children's TV programming and other programming of appeal to 4-15 year olds was banned by Ofcom in 2007 with restrictions fully implemented in 2009. An Ofcom analysis reported a 37% reduction in children's exposure to advertising of these foods in 2009 compared with 2005.<sup>81</sup> However, an academic study found that since the ban was introduced, relative exposure of all viewers to unhealthy food advertisements increased. Exposure of children to such advertisements increased, partly explained by the fact that children were exposed to advertising during programming not targeted by the ban.<sup>82,83</sup> NICE and other public health bodies argue that imposing a 9pm watershed would significantly reduce exposure to marketing of foods high in fat, salt or sugar.<sup>84</sup>

Non-broadcast media (cinemas, magazines, billboards, apps and the internet) are subject to regulation enforced by the Advertising Standards Authority. Concerns have been raised about food and drinks manufacturers' use of social media to market unhealthy food to children and peer-to-peer marketing, to encourage children to share marketing with friends online.<sup>85</sup> The Committee of Advertising Practice is examining children's understanding of the commercial intent of non-broadcast marketing and will publish guidance later in 2015.<sup>86</sup> Action on Sugar has called for a ban on advertising partnerships between food manufacturers and sporting events, arguing that this sends the message that increasing physical activity alone can prevent obesity.

**Economic Approaches**

An approach to discourage population level consumption is to tax sugar as a commodity or tax high sugar products. Reforms of EU sugar quotas under the Common Agricultural Policy (CAP) are likely to reduce the commodity price of sugar. The impact of CAP reform on food availability and consumption has been highlighted by NICE as a potential lever with which to improve health at a population level.<sup>87</sup> A key uncertainty about taxing high sugar products is how it influences consumer shopping and consumption. A tax on sugar-sweetened drinks in the UK has been modelled. A 20% tax (the minimum level likely to be effective) could reduce obesity by 1.3% (180,000 people), with young people benefitting the most.<sup>88</sup> The Children's Food Campaign's online tool also models possible impacts.<sup>89</sup> The Government considers that existing measures to reduce overall calories consumed are effective.<sup>90,91</sup>

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- <sup>90</sup> 13 May 2014, Written questions, House of Lords, 753 c471WA, HL7008
- <sup>91</sup> 28 Jan 2014 Oral questions, House of Commons, 574 c751