



Public Health
England

Protecting and improving the nation's health

Why 5%?

An explanation of the Scientific Advisory Committee on Nutrition's recommendations about sugars and health, in the context of current intakes of free sugars, other dietary recommendations and the changes in dietary habits needed to reduce consumption of free sugars to 5% of dietary energy

About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. It does this through world-class science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. PHE is an operationally autonomous executive agency of the Department of Health.

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Executive summary

The government asked the Scientific Advisory Committee on Nutrition (SACN) to provide clarification on the relationship between dietary carbohydrates (sugars, starches and fibre) and health in the light of new evidence that has emerged since the last review over 20 years ago. In June 2014 a draft report was published for a public consultation. A revised, final report was published in July 2015.¹

The objective was to identify the best quality evidence and so SACN restricted its review to evidence from randomised controlled trials and prospective cohort studies. These are considered to be the most robust study designs for diet and health research.

SACN's findings

Since carbohydrate recommendations were last considered in 1991, the evidence indicating that a high intake of free sugars is detrimental to several health outcomes has strengthened.

Higher consumption of sugars, and sugars-containing foods and drinks, is associated with greater risk of tooth decay in observational (prospective cohort) studies.

Randomised controlled trials, in adults consuming an unrestricted diet, indicate that increasing or decreasing the proportion of calories consumed as sugars leads to a corresponding increase or decrease in energy intake. These changes were achieved either via adjustment of other sources of energy (starches, protein and fat) or by replacement of sugars with non-caloric sweeteners particularly in drinks.

Randomised controlled trials in children and adolescents indicate that consumption of sugars-sweetened drinks, as compared with low calorie drinks, results in greater weight gain and increases in body mass index (weight for height). This finding suggests that there is inadequate energy (calorie)

The average intake, across the UK population, of free sugars should not exceed 5% of total dietary energy intake. This applies to all age groups from 2 years upwards.

This is part of a set of new dietary recommendations that includes an increase in dietary fibre intake.

Current average intakes of free sugars are at least twice the new 5% recommendation, and three times the 5% value in 11 to 18-year olds. Main sources are drinks and cereal products sweetened with sugars, confectionery, table sugar and fruit juice.

The consumption of sugars-sweetened drinks should be minimised in children and adults.

The new recommendation for sugars is designed to minimise risks associated with high free sugars intakes and to result in improved management of energy intake. It is expected to help with obesity risk reduction and to improve dental health.

¹ SACN (2015) Carbohydrates and Health. www.sacn.gov.uk

compensation for energy delivered as sugars. In other words, this means inadequate voluntary reduction in intake of other sources of calories.

Evidence from prospective cohort studies associates consumption of sugars-sweetened drinks with an increased risk of type 2 diabetes mellitus.

SACN advises that the term 'free sugars' should be adopted in the UK to describe the types of sugars that need to be consumed in smaller amounts.

SACN's proposed recommendations for carbohydrates including free sugars have been made in the context of an energy intake that is appropriate to maintain a healthy weight.

SACN advises that average intake, across the UK population, of free sugars² should not exceed 5% of total dietary energy intake. This applies to all age groups from 2 years upwards.

This sugars recommendation is part of a broader set of dietary recommendations for carbohydrate intake, in which total carbohydrate comprising all sugars and starches should provide around half the energy we consume, and dietary fibre intake should increase to 30g per day for adults (with proportionately lower fibre recommendations for children).

These carbohydrate recommendations sit within a set of reference values for other sources of energy (eg, fat and protein), vitamins and minerals that together describe a healthy and varied diet that is important for growth, health and wellbeing.

Current average intakes in all age groups are at least twice the new sugars recommendation and three times higher in 11 to 18-year olds. The main sources are sugars-sweetened drinks (including carbonated drinks, juice drinks, energy drinks, squashes and cordials); cereal-based products (biscuits, cakes, pastries and sweetened breakfast cereals); table sugar and confectionery; and fruit juice.

The recommended amount of free sugars has been halved. Dietary patterns will need to change if the sugars and also the new fibre recommendations are to be met.

Decreasing the average population intake of free sugars is one step that could be taken to help reduce the current UK overconsumption of calories in relation to energy requirements.

Most people have free sugars intakes above the 5% level. For those maintaining a healthy body weight, SACN advises that a reduction in free sugars is replaced by other carbohydrate sources.

For those who are overweight, the reduction in free sugars would not be replaced in full and would be part of a strategy to decrease energy intake.

² 'Free sugars' includes all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and unsweetened fruit juices. Under this definition lactose (milk sugar) when naturally present in milk and milk products and sugars contained within the cellular structure of foods (particularly fruits and vegetables) are excluded.

SACN advises that consumption of sugars-sweetened drinks should be minimised in children and adults.

The new dietary recommendation for free sugars is designed to minimise the health risks associated with high free sugars intakes and to result in improved management of energy intake, reducing this across the population by an average of 100kcal/day (418kJ/day). This is expected to beneficially influence risk of obesity and also to improve dental health.

For people of a healthy weight, SACN advises that the reduction in free sugars should be replaced by starches, sugars contained within the cellular structure of fruits and vegetables and, for those who consume dairy products, by lactose naturally present in milk and milk products. For those who are overweight, the reduction in free sugars would be part of a strategy to decrease overall energy (calories) intake.

Key numbers

- the recommended amount of free sugars has been halved from 10% of dietary energy to 5% or less
- Public Health England has calculated that this means:
 - no more than 19g/day of free sugars for children aged 4 to 6
 - no more than 24g/day for 7 to 10-year olds
 - no more than 30g/day for children from age 11 and adults
- 13% (one in eight) of adults already achieve this 5% dietary energy recommendation
- average intakes of free sugars across the age groups range from 49-64g/day in females and 63-84g/day in males
- highest intakes are in children aged 4 to 10 years (14.7% of dietary energy intake) and 11 to 18-year olds (15.4% of dietary energy, on average)
- sugars-sweetened drinks provide 30% of the free sugars intake of 11 to 18-year olds, on average, and 16% in younger children and adults

What are the new sugar recommendations?

Dietary carbohydrates and their role in health were last considered in the UK by the Committee on Medical Aspects of Food and Nutrition Policy (COMA) in reports published in the 1980s and 1990s. Since then considerable evidence has emerged on the role of carbohydrates in determining risk of heart disease and diabetes and in bowel and oral health. In 2008, the Food Standards Agency and the Department of Health asked the Scientific Advisory Committee on Nutrition (SACN) to provide clarification of the relationship between dietary carbohydrates and health and also to make public health recommendations.

SACN has now published a comprehensive review of the scientific evidence concerning carbohydrates and health. A feature of this report is its focus on sugars. It also looks in detail at dietary fibre and an increase in recommended intakes is proposed in the light of new and considerably stronger evidence.

The terms of reference of the SACN carbohydrates working group were to review:

- the evidence on dietary carbohydrate and colorectal health in adults (including colorectal cancer, irritable bowel syndrome, constipation) and in childhood and infancy
- the evidence on dietary carbohydrate and cardio-metabolic health (including cardiovascular disease, insulin resistance, glycaemic response and obesity)
- the evidence on dietary carbohydrates and oral health

SACN's review of the evidence in relation to sugars has concluded that:

- prospective cohort studies indicate that higher consumption of sugars and sugars-containing foods and drinks is associated with a greater risk of tooth decay
- randomised controlled trials in adults indicate that increasing or decreasing total energy (calorie) intake from sugars leads to a corresponding increase or decrease in energy intake
- in randomised controlled trials, consumption of sugars-sweetened drinks (compared to low calorie drinks) results in greater weight gain and increases in body mass index (weight for height) in children and adolescents
- there is no association between the incidence of type 2 diabetes and total or individual sugars intake. But prospective cohort studies associate greater consumption of sugars-sweetened drinks with increased risk of type 2 diabetes

On the basis of these findings, which are described in more detail in the section on SACN's review on page 15 of this document, SACN made the following recommendations in its report published in July 2015:

- the average intake across the UK population of free sugars³ should not exceed 5% of total dietary energy intake for age groups from 2 years upwards
- the consumption of sugars-sweetened drinks should be minimised in children and adults
- the term 'free sugars' should be adopted in the UK to describe the types of sugars that need to be consumed in smaller amounts. This term replaces 'non-milk extrinsic sugars' (see the section on What are free sugars? on page 9)

No quantitative recommendations are made for children under the age of 2 years due to the absence of information. But from about 6 months of age, gradual diversification of the diet to provide increasing amounts of whole grains, pulses, fruits and vegetables is encouraged.

³ 'Free sugars' includes all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and unsweetened fruit juices. Under this definition, lactose (milk sugar) when naturally present in milk and milk products and sugars contained within the cellular structure of foods (particularly fruits and vegetables) are excluded. More details can be found in the section on What are free sugars? on page 9).

What are 'free sugars'?

SACN uses a new term to describe the types of sugars that need to be reduced in the diets of most of us if the new dietary recommendation is to be achieved – 'free sugars'. This term has also recently been adopted by the World Health Organisation (WHO 2015).⁴ 'Free sugars' replaces the term non-milk extrinsic sugars (sometimes referred to as NMES), which has been in use in the UK for almost 25 years, although the details of the definition are very similar (see below).

'Free sugars' comprises all monosaccharides* and disaccharides* added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and unsweetened fruit juices. Under this definition lactose (the sugar in milk) when naturally present in milk and milk products and the sugars contained within the cellular structure of foods (particularly fruits and vegetables) are excluded.

*Monosaccharides are single sugar units (glucose and fructose) and disaccharides are two single units joined together (sucrose).

The term non-milk extrinsic sugars, used in the UK until now, captures all the sugars defined by the term 'free sugars' but in addition includes half of the sugars present in dried, stewed or canned fruit. The 50% was an arbitrary figure used to account for sugars released as a result of partial breakdown of the cellular structure during processing. So, overall, the new free sugars values will be slightly lower in some cases than the non-milk extrinsic sugars values, because 'free sugars' does not include sugars contributed by dried and processed fruits. The term 'non-milk extrinsic sugars' has been used exclusively by the UK, in particular to report sugars intakes in dietary surveys and to describe dietary targets for sugars. For this reason, the data in this document is largely presented in terms of non-milk extrinsic sugars, acknowledging that the values will be very similar to 'free sugars' in the majority of cases. Mean intakes of non-milk extrinsic sugars across the age groups (from age 4 years) range from 49-64g/day in females and 63-84g/day in males (more details can be found in the section on Sugars consumption in the UK on page 27).

As explained in the previous section, 'free sugars' is the particular category of sugars that is targeted for reduction to 5% of the calories we consume in the UK. Free sugars

⁴ WHO, World Health Organisation (2015) Guideline: Sugars intake for adults and children. Geneva: World Health Organisation.

are not the same as 'total sugars' as illustrated in the Table 1. There is the potential for confusion as food labelling legislation requires the declaration of total sugars, not free sugars. For example, a plain yogurt contains 9.9g total sugars but none of these are 'free sugars' as they are all derived from milk. The same applies to an individual portion of fresh fruit salad that might contain around 20g of sugars, depending on the fruits selected, all of which are naturally present within the cellular structure of the fruit (rather than 'free').

Table 1. Comparison of the total and free sugars content of foods

	Portion size	Total sugars (per portion)	Free sugars (per portion)	Comment
Regular cola	330ml	36.0g	36.0g	All of the sugars are present as free sugars.
Calorie-free cola	330ml	Zero	Zero	No sugars present
Lemonade	330ml	27.4g	27.4g	All of the sugars are present as free sugars.
Calorie-free lemonade	330ml	Zero	Zero	No sugars present.
Semi-skimmed milk	200ml	9.4g	Zero	None of the sugars are free sugars; all of the sugar is lactose from milk, which is excluded from the definition of free sugars.
Flavoured milk	200ml	28.0g	16.2g	The sugars are a mix of added 'free sugars' and lactose (from milk). Flavoured milk is permitted within the School Food Standards if it does not contain more than 5% added sugars.
Plain yogurt (low fat)	125g	9.9g	Zero	None of the sugars are free sugars; all of the sugar is lactose from milk, which is excluded from the definition of free sugars.
Fruit yogurt	125g	15.9g	11.25g	The sugars present are a mix of free sugars, sugars from the fruit (not 'free') and lactose from the milk (also excluded from the free sugars definition). Levels of free sugars vary and can be low when non-caloric sweeteners are used, but typically are 8-10g/100g; 9g/100g has been used here.
Diet fruit yogurt (low fat, no added sugar)	125g	7.8g	Zero	None of the sugars are free sugars. The sugars present are from milk (lactose) and fruit, which are both excluded from the definition of fruit sugars.
Portion of fresh fruit salad	140g	19.6g	Zero	None of the sugars are free sugars. The sugars present are within the fruit structure (a mixture of fructose, glucose and sucrose).
Banana	100g	18.1g	Zero	None of the sugars are free sugars.
Orange	160g	13.6g	Zero	None of the sugars are free sugars.
Orange juice (150ml)	150ml	12.9g	12.9g	All the sugars are classed as free sugars, released from the fruit during juicing.
Honey (5g)	5g	3.8g	3.8g	All the sugars are classed as free sugars.

Source: McCance and Widdowson's The Composition of Foods, Seventh Summary Edition. PHE 2014

Other terms in common use:

'**Added sugars**' refers to sugars and syrups that are added during manufacture and preparation but does not capture the sugars present in unsweetened fruit juice or honey. It is used in the USA and by the European Food Safety Authority.

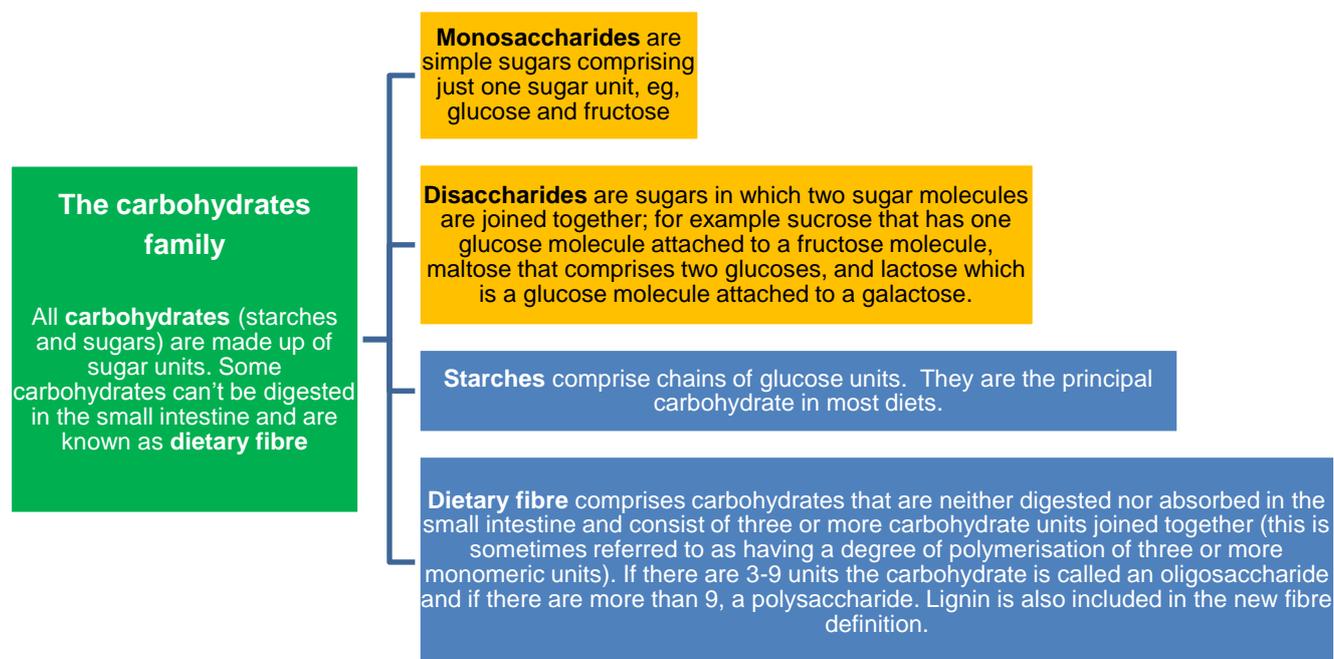
'**Total sugars**' describes the total amount of sugars from all sources (free sugars plus those from milk and those present in the structure of foods such as fruit and

vegetables). Food labelling legislation requires information about total sugars to be declared in the nutrition panel of food labels. Information about 'free sugars' per se does not appear although the ingredients list may be helpful. To identify sources of free sugars, words to watch out for on food labels are cane sugar, honey, brown sugar, high fructose corn syrup, fruit juice concentrate, corn syrup, fructose, sucrose, glucose, crystalline sucrose, nectars. Mean intakes of total sugar are around 95-103g/day in adults and children over 4 years and 76g/day in children aged 18 months to 3 years. In adults, total sugars provide 19.1% of total dietary energy intake (23.8% in 4 to 10-year-olds and 21.7% in 11 to 18-year-olds).

Sugars present in the cellular structure of fruit and vegetables are sometimes referred to as '**intrinsic sugars**'. Like the sugar in milk (lactose), these are excluded from the definition of free sugars. Mean intakes of intrinsic sugars (main source fruit) and milk sugars combined are 30-43g/day across the age groups, providing 6-10% of total dietary energy intake in adults and children aged 4 years upwards and 13% in children aged 1½ to 3 years.

Figure 1 describes the carbohydrates family. The two yellow boxes illustrate the potential sources of free sugars. SACN stresses the importance of using the word sugars rather than sugar, as the former captures the many forms of sugar that may be present in foods and drinks.

Figure 1. The carbohydrates family

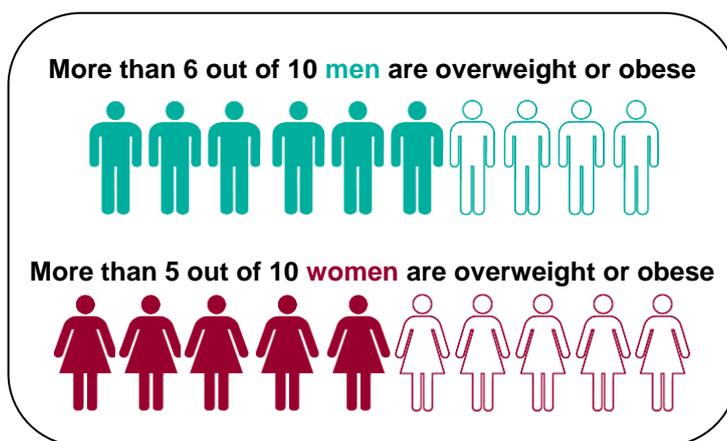


How are sugars linked to being overweight and obese and to type 2 diabetes?

Given the high rates of obesity in the UK, reducing the population's energy intakes is likely to be beneficial to health. Obesity occurs when energy intake from food and drink consumption is greater than energy expended over a prolonged period of time.

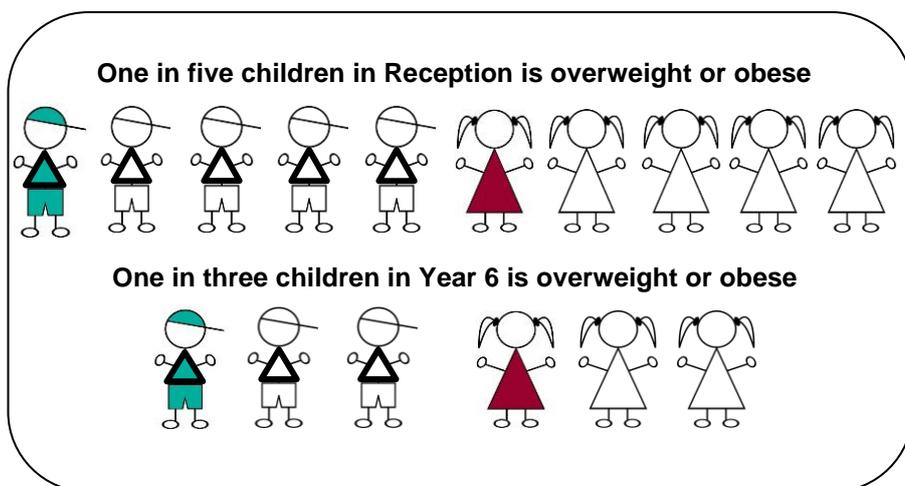
In the UK, obesity prevalence increased sharply during the 1990s and early 2000s. For example, in England, the proportion of adults categorised as obese (BMI 30kg/m² or over) was less than 10% in the 1980s and increased from 13.2% of men in 1993 to 24.7% in 2011-13 and from 16.4% of women in 1993 to 24.9% in 2011-13.⁵

Also in England, 9.7% of boys and 8.8% of girls (all 9.3%) aged 4 to 5 years and 20.4% of boys and 17.4% of girls (all children 18.9%) aged 10 to 11 years are classified as obese.⁵ In both age groups, a doubling in the prevalence of obesity was observed in children living in the most deprived areas compared to those in the least deprived.



Obesity is associated with greater risks of developing type 2 diabetes mellitus, hypertension, coronary artery disease and raised blood lipids, as well as some types of cancer and other diseases (Foresight, 2007⁶). SACN's analysis reveals that free sugars intake is a dietary factor

that increases energy intake in situations where food intake is unrestricted. Decreasing the population intake of free sugars (see What are the new sugar recommendations?, page 7) is one step that could be taken to help reduce the current UK overconsumption of energy in relation to energy requirements.



⁵ www.noo.org.uk/slide_sets

⁶ Foresight (2007) Tackling Obesity: Future Choices. www.bis.gov.uk/assets/foresight/docs/obesity/17.pdf

In 2013 the prevalence of diabetes in the adult population in England was 6%. It is estimated that 90% of these cases are type 2 diabetes (Diabetes UK, 2014).⁷ Obesity is associated with risk of this form of diabetes.

While the evidence considered by SACN did not indicate an association between sugars intake and incidence of type 2 diabetes, evidence from prospective cohort studies did show that greater consumption of sugars-sweetened drinks is associated with increased risk type 2 diabetes. SACN therefore advises that the consumption of sugars-sweetened drinks should be minimised (see the section on SACN's review on page 15).

- 2,500,000 people in England have type 2 diabetes
- 90% of people with diabetes have type 2 diabetes, which is largely preventable

⁷ Diabetes UK: www.diabetes.org.uk/About_us/What-we-say/Statistics/Diabetes-prevalence-2013/

How are sugars linked to tooth decay?

The 1991 dietary reference value for sugars (10% of total dietary energy, COMA, 1991)⁸ was based on the observation that dental caries (tooth decay) was rare in populations whose intakes were estimated to be around this level.

Dental caries is the result of demineralisation of enamel and dentine in the presence of acid. This acid is produced through the fermentation, by bacteria that reside in the mouth, of dietary sugars, particularly sucrose but also other sugars including those produced by hydrolysis of starch in the mouth. This demineralisation occurs during virtually all meals as naturally occurring sugars (as well as those added) are present in many foods. But mineral levels can subsequently be restored by saliva, an efficient remineralising solution containing the necessary calcium and phosphate. Tooth decay occurs when the frequency and extent of demineralisation exceeds the capacity of saliva to repair the damage. Fluoride can help teeth resist the demineralisation process.

Dental caries continues to be a widespread problem in the UK. The Adult Dental Health Survey found that 31% of adults in England, Wales and Northern Ireland experienced tooth decay in either the crown or root of the tooth (Steele & O'Sullivan, 2011).⁹ In 2012 over a quarter (27.9%) of 5-year olds in England had tooth decay (Public Health England, 2013).¹⁰ There are also marked inequalities across the regions: 21.2% of five-year-olds had tooth decay in South East of England compared to 34.8% in the North West of England, with even greater inequalities within local authority areas.

In the Children's Dental Health Survey, 57% of eight-year-olds had some kind of tooth decay in their primary dentition. In permanent teeth, 14%, 34% and 49% of 8, 12 and 15-year-olds, respectively, had obvious tooth decay (Lader et al 2003).¹¹

- 28% of 5-year olds in England had tooth decay in 2012
- 12% of 3-year olds had experienced tooth decay in 2013

SACN concludes that reducing consumption of free sugars will help reduce the risk of dental caries.

⁸ COMA (1991) Dietary Reference Values for Food Energy and Nutrients for the United Kingdom. London: HMSO

⁹ Steele & O'Sullivan (2011) Adult dental health survey 2009. The Health and Social Care Information Centre

¹⁰ Public Health England (2013) National Dental Epidemiology programme in England: oral health survey of five-year-old children 2012.

¹¹ Lader et al (2003) Children's Dental health in the United Kingdom

SACN's review

SACN's review was comprehensive and its report stretches to almost 400 pages. **Systematic reviews** of the literature were undertaken to identify the studies relevant to the task set (see the section on What are the new sugar recommendations? on page7).

The objective was to identify the best quality evidence and so SACN restricted its review to evidence from **randomised controlled trials** (which have the potential to demonstrate a causal relationship, eg, between an aspect of diet and a risk factor for disease) and **prospective cohort studies** (which reveal associations, eg, between an aspect of diet and a disease risk factor or endpoint) as these are considered the most robust study designs for diet and health research.

Strict inclusion and exclusion criteria for individual studies were applied to ensure the evidence considered was of sufficient quality to enable sound conclusions to be reached. For example, the duration of the study was a criterion.

The evidence that emerged from a series of systematic reviews was assessed and graded by SACN. Details of the grading scheme can be found in Annex 2 of the SACN report.

The evaluation considered whether intakes of specific carbohydrates are a factor in the risk for cardiovascular disease (heart disease and stroke), obesity, type 2 diabetes and colorectal (bowel) cancers. The evidence for a relationship between carbohydrates and oral health was also considered.

SACN's recommendations are based on only those relationships where the evidence met the required standards. Where they existed, **dose-response relationships** between carbohydrate intakes and health outcomes were considered and used to inform the dietary recommendations.

Systematic review: a literature review focused on a research question that identifies (using strict inclusion and exclusion criteria), appraises, and synthesizes all high quality research evidence relevant to that question.

Randomised controlled trial: a study in which subjects are assigned to different experimental intervention groups by chance (randomly) and outcomes are compared after sufficient follow-up time. These intervention studies are designed to test a hypothetical cause and effect relationship by modifying a supposed causal factor in a population. Randomisation is important to minimise the differences between groups.

Prospective cohort study: a type of observational study in which the subjects are identified, baseline measurements taken (eg, diet) and then subjects are followed forward in time, without any particular intervention. Observational studies such as these are prone to sources of bias and confounding by other dietary and lifestyle factors, whereby factors other than the specific ones being studied influence the associations found in the study. Therefore, any associations must be interpreted with caution.

Very few studies on the effects of individual sugars, such as glucose, fructose or sucrose, met the inclusion criteria. There was also insufficient evidence of appropriate quality to draw conclusions on the impact of sugars intake on the majority of **cardio-metabolic outcomes** in adults, including body weight.

Few trials on fructose met the inclusion criteria for the SACN report because many were either not randomised or they were of insufficient duration. No studies specifically investigating the effects of high fructose corn syrup were identified that met the inclusion criteria. However, as concern has been expressed around fructose consumption and its implications for cardio-metabolic health, evidence from trials that did not meet the inclusion criteria for SACN's report were considered. It was concluded that, on balance, there was insufficient evidence to demonstrate that fructose intake, at levels consumed in the normal UK diet, leads to adverse health outcomes independently of any effects related to fructose's presence as a component of total and free sugars. Details are provided in Annex 3 of the SACN report.

There was a lack of evidence to assess the impact of sugars intake on oral health in adults; evidence for a relationship comes from studies in children and adolescents. Most of the evidence on sugars and on sugars-sweetened foods and beverages considered in SACN's report is derived from prospective cohort studies.

Evidence from which SACN drew conclusions

Prospective cohort studies

Prospective cohort studies are observational in nature rather than involving an intervention and so cannot demonstrate a causal relationship, only an association. Generally, evidence from three or more such studies was used to judge whether an association existed, where possible supported by a **meta-analysis** of the combined data.

Expert judgement was also applied and where an association appeared to exist, the evidence was graded as adequate, moderate or limited (details of the evidence grading system used by SACN can be found in Annex 2 of the SACN report).

Confounding: this occurs in statistics when extraneous variables correlate with those factors being studied, either positively or inversely, and influence the result.

Dose response relationship: this is a direct relationship between a factor being studied (eg, sugars intake) and an outcome or risk factor.

Cardio-metabolic outcomes: these are outcomes related to heart disease, stroke and diabetes risk. They include body weight.

Meta-analysis: this is a statistical analysis that is applied to separate but similar experiments/studies that combines the individual results into a single piece of evidence.

Tooth decay

The evidence for a relationship between sugars intake and tooth decay comes from mainly prospective cohort studies and some trials, conducted in children and adolescents. Studies that adjusted results for tooth brushing frequency were given more weight during the assessment because oral hygiene practices may have affected results. SACN concluded that decreased consumption of free sugars would help to lower the risk of dental decay, which continues to be a problem in the UK.

In children and adolescents:

- higher consumption (ie, the amount) of sugars, sugars-containing foods and sugars-sweetened drinks is associated with a greater risk of dental caries in the deciduous (first) and permanent teeth (see paragraphs 6.52-6.55, 6.58-6.64 of the SACN report)
- a higher frequency of consumption of sugars-containing foods and drinks, but not total sugars intake, is also associated with greater risk of dental caries in the deciduous (primary teeth) and permanent teeth (see paragraphs 6.56-6.64 of the SACN report)

SACN comments that the lack of association observed between frequency of total sugars intake and risk of tooth decay may in part be due to methodological problems in the definition and characterisation of eating events in observational studies. Also, identifying the relationship between risk of tooth decay and sugars intake is **confounded** by oral hygiene and global preventative measures (eg, fluoride use) that have reduced the incidence of tooth decay worldwide.

In adults:

- there was a lack of evidence to assess the impact of sugars intake on oral health in adults, but SACN comments that the mechanism for the development of dental caries is the same for adults and children

Cardiovascular disease, colorectal cancer and type 2 diabetes

The findings from prospective studies were:

- there is insufficient evidence to enable conclusions to be drawn in relation to cardiovascular disease risk factors or endpoints (events) (see paragraphs 6.6-6.17 of the SACN report)
- sugars or sugars-sweetened beverage intake are not associated with the incidence of colorectal cancer (see paragraphs 6.38-6.39 of the SACN report)
- there is no association between the incidence of type 2 diabetes and total or individual sugars intake (see paragraphs 6.23-6.34 of the SACN report)

- but a greater risk of type 2 diabetes is associated with a higher intake of sugars-sweetened beverages. This finding was not supported by the limited evidence from randomised trials, which showed no effect of diets differing in sugars content on blood sugar and insulin levels or on insulin resistance (see paragraphs 6.25-6.28 of the SACN report)

SACN comments that the reason for this discrepancy with type 2 diabetes, between the results of prospective studies and randomised controlled trials, is not clear. Presumably the increased risk might reflect higher energy intakes among those with higher intakes of sugars-sweetened drinks. In a meta-analysis of prospective cohort studies, incidence of type 2 diabetes increased by 23% for each additional 330ml/day of sugars-sweetened drinks consumed (see paragraphs 6.35-6.37 of the SACN report).

Randomised controlled trials

Although most of the evidence available that met SACN's inclusion criteria came from prospective, observational cohort studies, some randomised controlled trials also met the inclusion criteria. Randomised controlled trials can provide evidence of causal relationships rather than associations. Generally, there needed to be three or more randomised controlled trials to determine whether or not there was evidence of an effect. Where an effect appeared to be present, the evidence was graded by SACN as adequate, moderate or limited.

Energy intake, body weight and cardio-metabolic outcomes

Energy intake

Randomised controlled trials conducted in adults indicate that increasing or decreasing the percentage of total dietary energy consumed as sugars, when eating an unrestricted diet, leads to a corresponding increase or decrease in energy intake. Change in the percentage of dietary energy provided as sugars was achieved in these trials either through adjustment of other macronutrient (energy-providing) components or by replacing sugars with non-caloric sweeteners. **Meta-analyses** were undertaken using the randomised controlled trials identified, and used to inform the new free sugars recommendation. Further details can be found in paragraphs 6.18-6.22 and Annex 9 of the SACN report.

Sugars-sweetened drinks and weight gain in children and adolescents

Randomised controlled trials conducted in children and adolescents indicate that consumption of sugars-sweetened drinks, as compared with non-calorically sweetened drinks, results in greater weight gain and increases in body mass index (see paragraphs 6.47-6.51 of the SACN report). The findings, which are limited to a small number of studies and not supported by the limited evidence from prospective studies, suggest

that there is inadequate energy compensation for energy delivered as sugars. In other words, the degree of voluntary reduction in intake of other foods or drinks is insufficient.

Cardio-metabolic outcomes

Randomised controlled trials examining cardiovascular risk factors, body weight, inflammatory markers and risk factors for type 2 diabetes demonstrate no effects of increasing sugars intake.

There is also insufficient evidence to assess the link between individual sugars and sugars-sweetened foods and drinks and cardio-metabolic outcomes.

Why 5%?

A free sugars intake of 5% or less of total dietary energy intake, on average across the population, has been recommended by SACN as the new dietary recommendation for sugars. SACN made this recommendation after considering the results of eleven randomised controlled trials that presented evidence on diets differing in the proportion of sugars in relation to energy intake.

In five of the trials, the sugars content of participants' diets was manipulated by adjusting other sources of energy (starches, protein, and fat). In six of the trials, the amount of sugars participants consumed was altered predominantly by replacing sugars with non-caloric sweeteners, particularly in drinks.

Data from the eleven trials were analysed all together using a technique known as meta-analysis (see page 16). This statistical analysis indicated that in these studies there was an association between sugars consumption and energy intake. It demonstrated that relative changes (increases and decreases) in sugars intake resulted in corresponding relative changes in energy intake and that there was approximately a 19kcal (78kJ) change in energy intake for each one unit change in percentage energy consumed as sugars. With the exception of one study, the same direction of effect was observed in each of the trials. SACN's interpretation of this finding is that participants in these studies made inadequate energy compensation for energy derived from sugars; in other words, the extent of voluntary reduction in their consumption of other foods and drinks was insufficient.

To test their conclusion, SACN conducted a second meta-analysis using slightly different data from the eleven randomised controlled trials. This showed the same relationship between sugars and energy intake as in the first analysis but gave a slightly larger quantitative effect. SACN used the more conservative result, from the first meta-analysis, as the basis for deriving its new recommendation for the population's sugars intake. Details of the eleven randomised controlled trials and SACN's meta-analyses can be found in paragraphs 6.18 to 6.22 and Annex 9 of the SACN report.

To quantify the dietary recommendation, SACN considered advice from the Calorie Reduction Expert Group which estimated that a 100kcal/person/day (418kJ/person/day) reduction in energy intake of the population would address energy imbalance and lead to a moderate degree of weight loss in the majority of individuals (Calorie Reduction Expert Group, 2011).¹² SACN calculated that in order to achieve an average reduction in population energy intake from free sugars of 100kcal/person/day (418kJ/person/day)

¹² Calorie Reduction Expert Group (2011) Statement of the Calorie Reduction Expert Group.
www.gov.uk/government/uploads/system/uploads/attachment_data/file/215561/dh_127554.pdf

free sugars intake would need to be reduced by approximately 5% of total dietary energy. Details of SACN's calculations can be found in paragraphs 11.6-11.16 of the SACN report.

SACN notes that the actual, sustained effect size in populations may differ from that observed in these eleven trials and, therefore, that the estimated figure of 5% should be treated with some caution. Nonetheless, SACN advises that these calculations provide a useful guide on which to make an informed judgement based on the evidence. Using this 5% figure and the current recommendation for non-milk extrinsic sugars of 10% of total energy intake, SACN arrived at its dietary recommendation that the population average intake of free sugars should not exceed 5% of total dietary energy.

This recommendation is part of a broader set of recommendations for carbohydrate intake, in which total carbohydrate comprising all sugars and all starches should provide around half the energy we consume in total and that dietary fibre intake should increase to 30g per day; an additional 12g on top of the current estimated average intake of about 18g/day (expressed as AOAC fibre). These carbohydrate recommendations sit within a set of reference values for other sources of energy (eg, fat and protein), vitamins and minerals that together describe a healthy and varied diet that is important for growth, health and wellbeing.

The new dietary recommendation for sugars is designed to minimise the risks associated with high free sugars intakes and to result in improved management of energy intake, by reducing energy (calorie) intake across the population by an estimated 100kcal per day (418kJ per day). This is expected to beneficially influence obesity risk and also to improve dental health.

The dietary recommendation for free sugars has been derived from calculations assuming that the whole 100kcal (418kJ) reduction would come from the effects of reduced sugars intakes. SACN acknowledges that in reality this would not be the case but suggests nevertheless that lowering free sugars intakes provides one approach to lowering the average total dietary energy intake of the population. SACN also acknowledges that there is nothing specific about the effect of sugars when energy intake is held constant, apart from where dental caries is concerned.

Is 5% achievable?

Analyses in the USA by the US Department of Agriculture suggest that healthy USA-style diets provide 6-7% of energy as 'added sugars', with healthy Mediterranean-style diets typically providing 6% (USDA 2015).¹³ The new UK sugars recommendation will be challenging to achieve and is stricter than recommendations recently published in

¹³ USDA (2015) Dietary Guidelines for Americans. www.health.gov/dietaryguidelines/2015-scientific-report/

the USA (USDA 2015; 10% of dietary energy as added sugars - this definition does not include the sugars in fruit juice and honey, for example) and published by the World Health Organisation earlier this year (WHO 2015).¹⁴ WHO made a strong recommendation that free sugars should be reduced to less than 10% of total energy intake and a conditional recommendation (owing to the nature of the evidence) for a further reduction to below 5% of total energy intake.

Average intakes of free sugars currently exceed the 5% level by a substantial margin in all age groups, as shown in the section on What are 'free sugars'? on page 9. Table 2 compares current intakes of free sugars with the new recommendations. It shows that current intakes are two to three times higher than the new recommendation.

Table 2. A comparison of current intakes (g/day) with the new recommendations for free sugars

Age	Recommended maximum free sugars* intake (also see Table 1)	Current intakes of free sugars* in males, g/day	Current intakes of free sugars* in females, g/day
4-6 years	No more than 19g/day	63g (4-10 years)	58.5g (4-10 years)
7-10 years	No more than 24g/day		
From 11 years, including adults	No more than 30g/day	84g (11-18 years) 68.4g (19-64 years) 58.5g (65+ years)	63.9g (11-18 years) 49.2g (19-64 years) 46.2g (65+ years)

* expressed as non-milk extrinsic sugars; data from Bates et al 2014

Nevertheless, as illustrated in the section on Sugars consumption in the UK on page 27, 13% of adults are already achieving the 5% dietary energy level for free sugars intake. Dietary modelling with everyday foods shows that a diet that provides 5% or less of free sugars, the new target for fibre of 30g/day (in itself a challenging target given current intake levels), and also meets other dietary reference values for nutrients is possible although it will inevitably result in a dietary pattern that is dissimilar to the diets consumed by many in the UK currently.

The British Nutrition Foundation has developed some example menu plans to illustrate how the new free sugars and fibre recommendations can be met over a period of a week in a varied diet that meets dietary reference values and food based dietary guidelines (eg, at least five portions of fruit and vegetables, two portions of fish, one of which is an oily fish). A couple of examples are reproduced here and more can be found

¹⁴ WHO, World Health Organisation (2015) Guideline: Sugars intake for adults and children. Geneva: World Health Organisation.

at www.nutrition.org.uk. The points to note are that the menus feature high fibre varieties of starchy foods and at least five portions of fruit and vegetables daily to achieve the 30g fibre, with fruit juice limited to one 150ml glass a day. The majority of other drinks are water, low calorie drinks, and unsweetened tea and coffee with milk. Some snacks and desserts with added sugars are included but most snacks are fibre-rich ones. The type of diet that emerges is not representative of the average diet eaten in the UK and will require a substantial change in dietary habits for most people and considerable support and practical advice from multiple stakeholders. Innovative food solutions from manufactures and retailers may also be needed to help consumers achieve the recommendations.

Table 3. Sample diet plans providing an average of approximately 2000kcal (8400kJ)

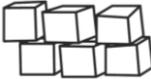
	Day 1	Day 2
Breakfast	2 slices of granary toast with peanut butter, skinny latte, 150ml fruit juice	Half can of reduced sugar baked beans, slice of wholemeal toast, skinny latte
Lunch	Chicken and whole wheat pasta salad, dried apricots	Tomato soup, ham salad sandwich, wholemeal bread
Evening meal	Baked salmon, new potatoes, broccoli and kale	Lean steak and vegetable stir fry with noodles
Drinks and snacks (8-10 glasses of fluids a day – water, no calorie/very low calorie drinks, unsweetened tea/coffee with milk)	Smoothie made with skimmed milk, low fat plain yogurt and frozen berries 2 chocolate digestives	Low fat plain yogurt, berries, pumpkin seeds 30g plain crisps
Free sugars, % energy	5.6%	4.0%
Fibre, g	32.6g	41.1g

What do the new recommendations mean?

The new carbohydrate recommendations mean that most people need to reduce the amount of free sugars they consume and increase the amount of fibre. As discussed in more detail later, in all age groups, current intakes of free sugars are already above the recommendation for sugars set in 1991 (no more than 10% of total energy (calorie) intake from non-milk extrinsic sugars; see the section on What are 'free sugars?' on page 9 for the definition). Now that the recommended amount has been halved for free sugars and for fibre has increased by a quarter, dietary patterns will need to change if the new recommendations are to be met.

To help visualise what the sugars recommendation means in practice, Public Health England has converted the recommendation of 5% of dietary energy intake into grams of free sugars per day for different age groups. These amounts are shown below (Table 4), together with a visualisation in terms of number of sugar cubes, which is based on an average 4g sugar cube. The use of sugar cubes is of course an oversimplification as packet sugar is only one of a number of contributors to free sugars. A comprehensive list is provided below in the footnote to the table.

Table 4. Visualisation of the new sugars recommendations

Age	Recommended maximum free sugars ^a intake, g per day ^b	Sugar cubes ^c
4-6 years	No more than 19g/day	5 cubes 
7-10 years	No more than 24g/day	6 cubes 
From 11 years, including adults	No more than 30g/day	7 cubes 

^a Free sugars are sugars that have been added by a food manufacturer, cook or consumer to a food and include those sugars naturally found in fruit juice, honey and syrups. They do not include sugars naturally found in milk and milk products nor in fruit and vegetables. To identify sources of free sugars, words to watch out for on food labels are cane sugar, honey, brown sugar, high fructose corn syrup, fruit juice concentrate, corn syrup, fructose, sucrose, glucose, crystalline sucrose, nectars.

^b Current intakes are on average 2-3 times higher than these recommended amounts. More information can be found in the section on What are 'free sugars?' on page 9.

^c The size and weight of sugar cubes varies; a 4g (silver spoon) sugar cube has been used

www.silverspoon.co.uk/products/drinks-and-sprinkling/cubes-and-crystals/white-sugar-cubes (date accessed: 10/07/2015).

SACN's new dietary recommendation on free sugars sits within a broader set of carbohydrate-related recommendations on total carbohydrate and dietary fibre, which have been proposed in the context of an energy intake that is appropriate to maintain a healthy weight (see Table 5). These recommendations in turn sit within the existing recommendations for intakes of protein, fat, saturated fat, salt, vitamins and minerals.

Dietary carbohydrates in total should continue to provide about half of all the energy we consume and intakes of dietary fibre should increase to 30g/day for adults (from the current recommendation of 23-24g); proportionally less for children (Table 5). The new fibre target has increased by around a quarter but current intakes already fall below the existing recommendation, which is estimated to be about 18g/day (expressed as AOAC fibre) in adults. This means that many people need to increase their fibre intake substantially.

Table 5. Comparison of recommendations for intakes of total carbohydrate, free sugars and dietary fibre with current intakes (as a percentage of dietary energy) for children, teenagers and adults

	Old recommendation	New recommendation	Current intakes			
			Children 4-10 y	Teenagers 11-18 y	Adults 19-64y	Older adults 65y plus
Free sugars (% total dietary energy) ^a	No more than 10% ^b	No more than 5%	14.7%	15.4%	11.5%	11.2%
Total carbohydrate (% total dietary energy) ^a	Approx. 50%	Approx. 50%	52.1%	50.6%	45.7%	45.8%
Dietary fibre ^c g/day, adults	About 23-24g ^c (adults)	30g ^c (adults)	-	-	About 18g ^c	About 18g ^c
Dietary fibre ^c g/day, children	-	15g ^c (2-5 years) 20g ^c (5-11 years)	About 14.5g ^c	-	-	-
Dietary fibre ^c g/day, teenagers	-	25g ^c (11-16 years) 30g ^c (16-18 years)	-	About 15g ^c	-	-

^a including energy from alcohol; ^b expressed as non-milk extrinsic sugars; ^c expressed as AOAC fibre

In order to address the imbalances between recommendations and intakes, illustrated in Table 5, dietary patterns need to change so that a greater proportion of dietary energy is derived from foods that are lower in free sugars and higher in dietary fibre, whilst continuing to derive approximately 50% of total dietary energy from carbohydrates, and of course meeting the recommendations for all other nutrients.

With regard to dietary carbohydrates in general, SACN recommends a dietary pattern that is based on a variety of food sources but limits the amounts consumed of table

sugar and major sources of free sugars, such as preserves and sweet spreads, confectionery, biscuits, buns and cakes. In particular, SACN advises that sugars-sweetened drinks should be consumed in minimal amounts (ie, infrequently and in small quantities).

For overweight individuals, SACN advises that reducing the amount of energy consumed as free sugars, without increasing energy intake from other sources, could contribute to a reduction in total energy intake and result in weight loss. For individuals who are maintaining a healthy body weight, the reduced intake of energy from free sugars (to achieve the 5% energy level) should be replaced by energy from starches (especially high fibre starchy foods such as wholegrain cereals, wholemeal bread and pasta, brown rice, jacket potatoes and pulses), sugars contained within the cellular structure of foods such as fruit and vegetables, and by lactose naturally present in milk and milk products (such a plain yogurt and some cheeses).

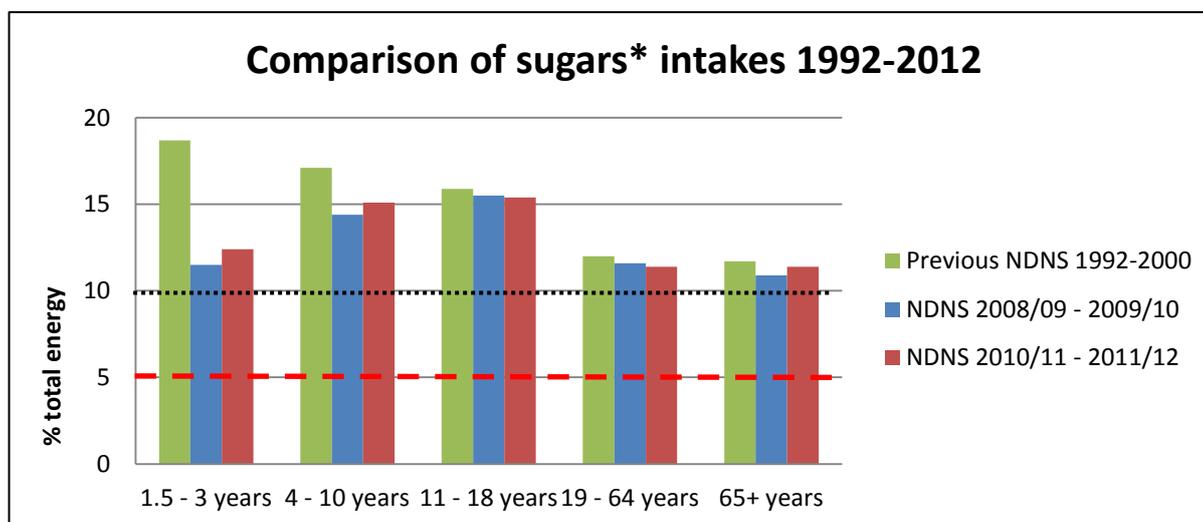
An idea of what this might mean in practice can be found in the section on Why 5%? on page 20.

Sugars consumption in the UK

Nationally representative data on carbohydrate intakes of the UK population are provided by the National Diet and Nutrition Survey (NDNS) rolling programme, a continuous survey of diet and nutrition in adults and children aged 18 months upwards (Bates et al 2014).¹⁵ In this survey, the closest sugars category to free sugars is non-milk extrinsic sugars.

Current average intakes of free sugars (expressed as % energy from non-milk extrinsic sugars) exceed recommendations (old and new) in all age groups, and are at least twice the new recommendation. See Figures 2 and 3. Intakes are highest in children aged 4 to 10 years and children aged 11 to 18 years (14.7% and 15.4% of total dietary energy intake respectively). The highest intakes recorded (the top 2.5%) are 25-30% of total dietary energy intake. Intakes are similar in men and women, though marginally higher in men in most age groups. Total amounts consumed in terms of grams of free sugars per day are higher in men than in women (see Figure 3 on page 28).

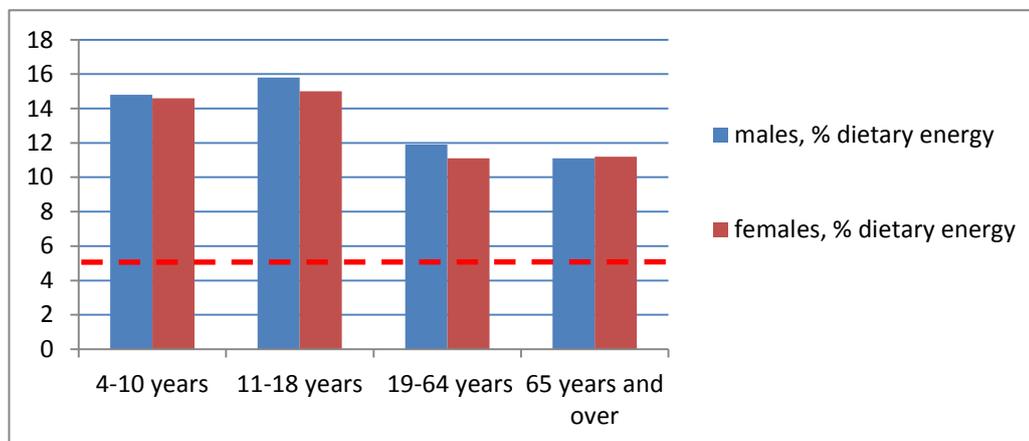
Figure 2. Comparison of sugars intakes over the period 1992-2012



* Sugars intakes measured as non-milk extrinsic sugars; data from the National Diet and Nutrition Survey (NDNS) – surveys in the 1990s compared with the Rolling Programme 2008-2012; Source: Bates et al. 2014. Red dashed line is the new recommendation. Dotted black line is the previous (10% of total dietary energy) recommendation.

¹⁵ Bates et al (2014) National Diet and Nutrition Survey. Headline results from years 1,2,3,4 of the Rolling Programme (2208/9-2011/12). Public Health England: London.

Figure 3. Current intakes of sugars* as a percentage of total dietary energy intakes; males versus females (source NDNS, Bates et al 2014¹⁶)

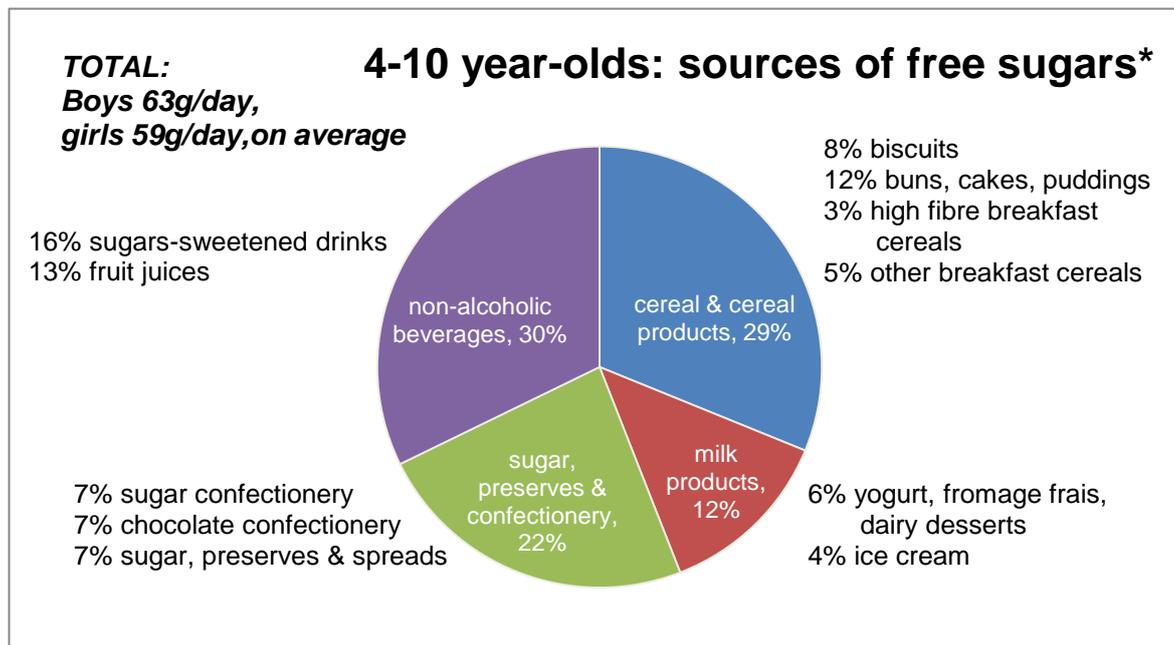


* Sugars intakes measured as non-milk extrinsic sugars; data from the National Diet and Nutrition Survey (NDNS Rolling Programme 2008-2012; Source Bates et al 2014. Red dashed line is the new (5% dietary energy) recommendation.

As is evident from the three pie charts (Figures 4-6), the relative proportions of the main dietary sources vary with age. Sugars-sweetened drinks (including carbonated drinks, juice drinks, energy drinks, squashes and cordials) provide 30% of non-milk extrinsic sugars intake in the 11 to 18 year age group and 16% in younger children and adults. Fruit juice provides a further 10% of energy in the 11 to 18 year age group and 13% in younger children. Cereals and cereal products provide about a quarter (22-29%) of NMES intake in children, mainly from sugars added to biscuits, buns, cakes, pastries and breakfast cereals. Older adults (65 years and over) had the lowest average (11.2% of total dietary energy). In this age group, the contribution from cereals and cereal products was higher and that from drinks was lower than in other age groups.

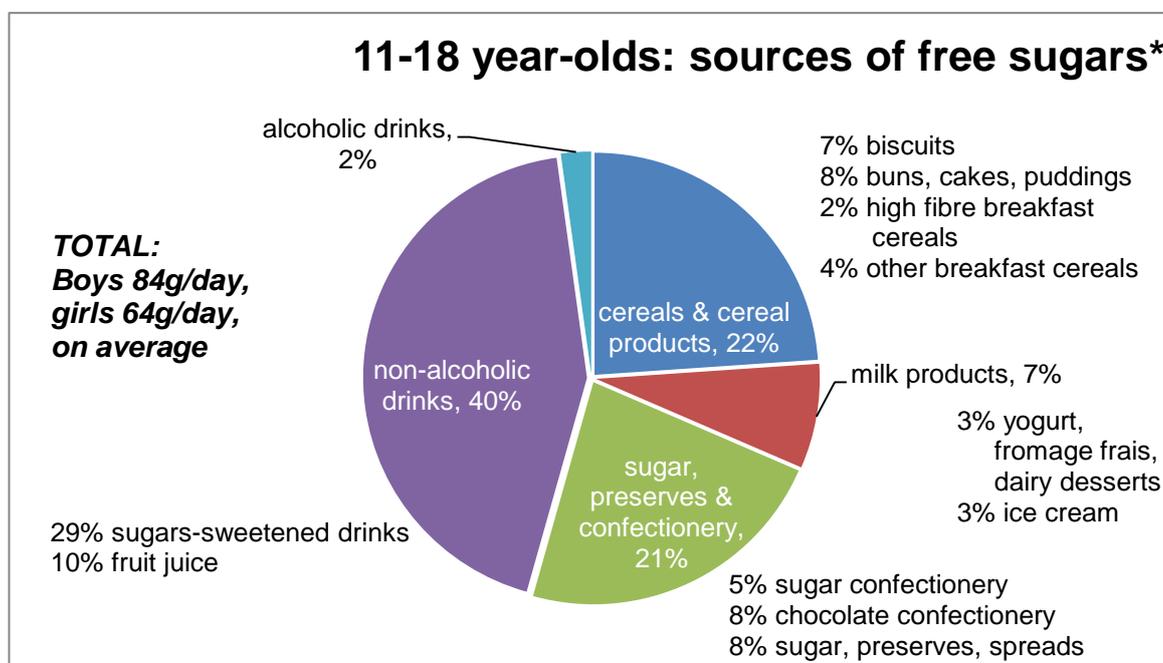
¹⁶ Bates et al (2014) National Diet and Nutrition Survey. Headline results from years 1,2,3,4 of the Rolling Programme (2208/9-2011/12). Public Health England: London.

Figure 4. Sources of free sugars in children aged 4-10 years



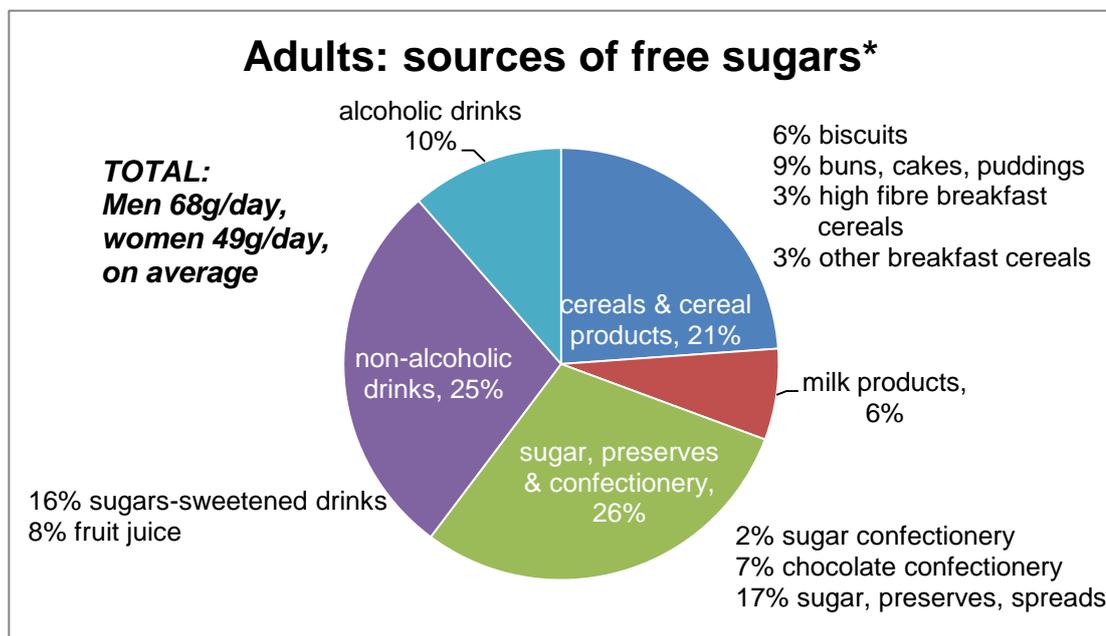
* Sugars intakes measured as non-milk extrinsic sugars; data from the National Diet and Nutrition Survey (NDNS) Rolling Programme 2008-2012. Source: Bates et al 2014.

Figure 5. Sources of free sugars in young people aged 11-18 years



* Sugars intakes measured as non-milk extrinsic sugars; data from the National Diet and Nutrition Survey (NDNS) Rolling Programme 2008-2012. Source: Bates et al 2014.

Figure 6. Sources of free sugars in adults aged 19-64 years



* Sugars intakes measured as non-milk extrinsic sugars; data from the National Diet and Nutrition Survey (NDNS) *Rolling Programme 2008-2012*. Source: Bates et al 2014.

In terms of quantities drunk, the NDNS reveals that consumption of sugars-sweetened drinks was highest in 11 to 18-year olds, at an average of 310ml/day in boys (80% of boys in this age group consumed these drinks; average intake among consumers was 387ml/day). For girls in the same age group, average intake was 210ml/day (279g/day among consumers, 75% consumed sugars-sweetened beverages).

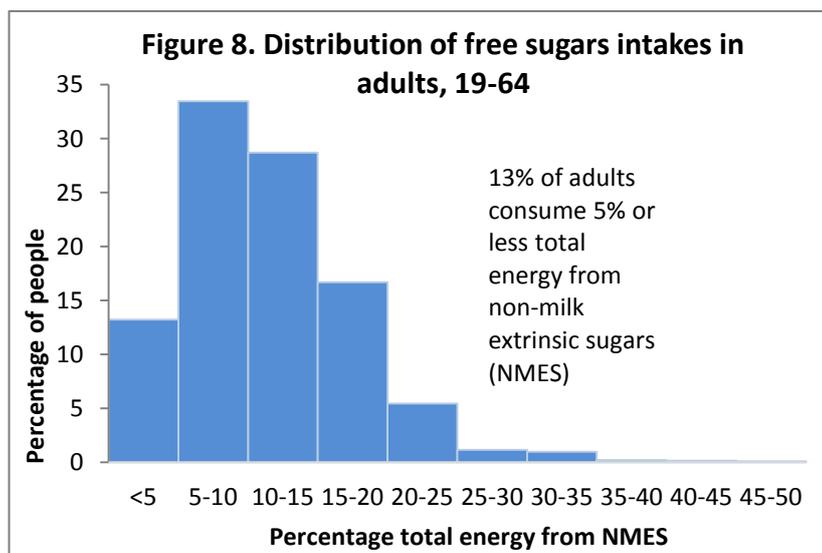
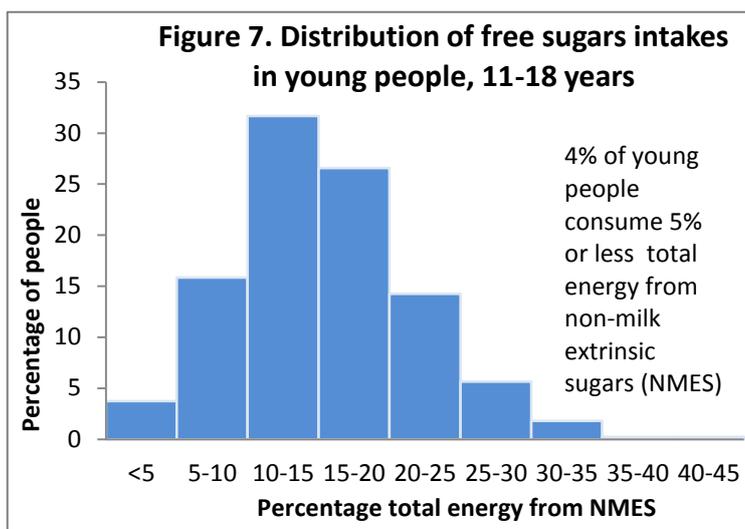
Average consumption in the 4 to 10 year age group was lower at 139ml/day in boys and 117ml/day in girls. Average intakes among consumers in this age group were 203ml/day for boys and 167ml/day in girls, with 68% and 70% respectively consuming these drinks. A small can contains 250ml, a standard can 330ml.

Average consumption of fruit juice was highest in children aged 4 to 10 years, at 93ml/day, with average intake of 151ml/day among consumers (62%). In children aged 11 to 18 years, average intake was 83ml/day, and was 170ml/day among consumers (49%). Mean consumption in other age groups was 50-60ml/day with 40-50% consuming fruit juice during the survey. Government advice is that fruit juice counts towards '5 a day' but that daily intake should be restricted to 150ml (one small glass) as it is a source of free sugars.

Children aged 4 to 18 years consumed an average of 18-19g/day of sugar and chocolate confectionery combined. Adults consumed 11-14g/day of table sugar, preserves and sweet spreads (mainly as table sugar).

There is evidence from NDNS of changes in free sugars and dietary fibre intakes as income falls. Intakes of free sugars as a percentage of energy were higher in adults in lower income groups. For example in women aged 19-64 years, mean intake of free sugars was significantly higher in the lowest fifth (12.7% of total dietary energy) compared with the highest fifth for income (10.0% of total dietary energy). This pattern was not seen in children and, in boys aged 4 to 10 years, the lowest fifth had a significantly lower percent energy from free sugars than did the highest. For dietary fibre, intakes were lowest in the bottom fifth in terms of income compared with the top fifth. This relationship was evident in children as well as adults.

Evidence from other government surveys confirms these relationships between income level and intakes of sugars and fibre. The Family Food Survey,¹⁷ based on household food purchases, found that the proportion of energy coming from free sugars in the household diet was higher in the lowest income group compared with the highest (and the fibre content of food purchased by households in the lowest income quintile (fifth) was lower than in the highest quintile). The UK Low Income Diet and Nutrition Survey¹⁸ carried out in 2003-2005 found that intakes of free sugars (as a percentage of energy) were higher than the current NDNS and also higher than in previous NDNS carried out in the 1990s (mean intakes of fibre were lower than current and previous intakes in NDNS).



The distribution of free sugars intakes is shown in Figures 7 and 8, emphasising that 4% of teenagers and 13% of adults have intakes of free sugars aligned with the new dietary recommendation.

¹⁷ Family Food Survey, www.gov.uk/government/collections/family-food-statistics

¹⁸ Low Income Diet and Nutrition Survey, www.food.gov.uk/science/dietarysurveys/lidnsbranch