3.

Low/no calorie sweeteners' use and role in sugar reduction and a healthy diet

At a time when the rates of obesity and non-communicable diseases (NCDs) continue to increase worldwide, and amid strong recommendations to limit free sugars intake, low/no calorie sweetened products can help individuals reduce the consumption of dietary sugars as part of a healthy eating plan.

Low/no calorie sweeteners (LNCS) are used in food and drink products in place of sugar to confer the desired level of sweetness while contributing very little or no energy at all to the final product. Therefore, LNCS represent a helpful tool in food reformulation and public health efforts aiming at sugar reduction.

The use of low/no calorie sweeteners

All approved LNCS are used in food and beverages as well as in table-top sweeteners in place of sugar and other caloric sweeteners to provide the desired sweetness with fewer or zero calories *(Gibson et al, 2014)*. LNCS have a much greater sweetening power compared to sugar, meaning that they are hundreds of times sweeter than sugar by weight (Figure 1), and therefore, LNCS are used in very small quantities in food and drink products *(Magnuson et al, 2016)*.

A variety of food and drink products, including soft drinks, table-top sweeteners, chewing gum, confectionery, yogurts, and desserts, can be sweetened with LNCS, in line with local regulatory requirements. LNCS are also used in healthcare products such as in mouthwashes, chewable multivitamins, and cough syrups, thus making these products more palatable. LNCS are clearly labelled on the packaging of food, drink and healthcare products that contain them, as discussed in Chapter 2.

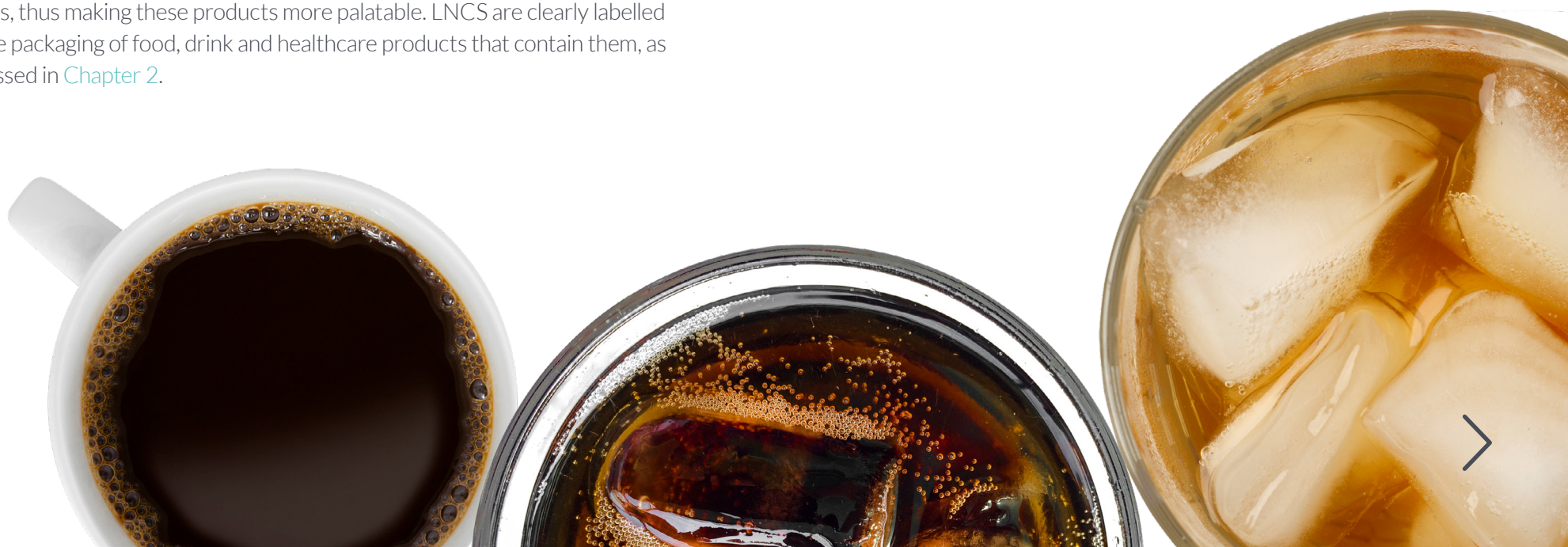

Figure 1: EU references to sweetness potency of low/no calorie sweeteners

Acesulfame K
Approx. **200 times** sweeter than sugar by weight

Aspartame
Approx. **200 times** sweeter than sugar by weight

Cyclamate
Approx. **30-40 times** sweeter than sugar by weight

Saccharin
Approx. **300-500 times** sweeter than sugar by weight

Sucralose
Approx. **600-650 times** sweeter than sugar by weight

Thaumatin
Approx. **2000-3000 times** sweeter than sugar by weight

Neohesperidine DC
Approx. **1000-1800 times** sweeter than sugar by weight

Steviol glycosides
Approx. **200-300 times** sweeter than sugar by weight

Neotame
Approx. **7000-13000 times** sweeter than sugar by weight

Advantame
Approx. **37000 times** sweeter than sugar by weight

Sources:
1. Commission Regulation (EU) No 231/2012 of 9 March 2012 laying down specifications for food additives listed in Annexes II and III to Regulation (EC) No 1333/2008 of the European Parliament and of the Council. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012R0231
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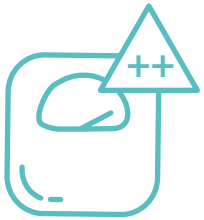
Food reformulation and sugar reduction: the key role of low/ no calorie sweeteners

As the rates of obesity and accompanying NCDs continue to increase globally, public health authorities are encouraging food manufacturers to replace sugars and reduce calories in their products as part of their reformulation goals. LNCS represent a helpful tool for developing such products *(Gallagher et al, 2021)*. They can facilitate substantial reductions in sugars and help to reduce calories when used in place of higher energy ingredients *(Gibson et al, 2017)*.

By having a very high sweetening power compared to sugars, LNCS are used in minute amounts to confer the desired level of sweetness to foods and drinks, while contributing very little or no energy at all to the final product. This offers one major advantage to food and drink as well as to table-top sweetener manufacturers and ultimately consumers – sweet taste whilst eliminating or substantially reducing the calories in a food or drink when replacing sugars.



the rates of obesity and non-communicable diseases continue to increase worldwide

LNCS can facilitate substantial sugar reduction in foods and drinks

Opportunities and challenges in food reformulation

Removing significant amounts of sugars from a food or drink has a noticeable effect on the sensory profile of the product, which can impact on overall consumer liking for the product. With few options available for giving food and beverages a palatable sweet taste without the calories of sugars, LNCS are important ingredients for the food industry *(Gibson et al, 2017; Miele et al, 2017; McCain et al, 2018)*. Other than sweetness, sugar has more functional properties in foods providing, for example, bulk and/or textural qualities. As a result, sugar reduction in food formulation is sometimes more complicated that just removing sugar from the food. Thus, innovation and advances in recipe development from the food and drink industry have made possible a wide variety of great-tasting food and beverage products sweetened with LNCS.

The increased range of available LNCS, and the fact that these can be used either alone or in blends, is a useful tool in food reformulation efforts. LNCS can be used synergistically in blends to achieve the desired sensory profile at lower levels of use *(Ashwell et al, 2020)*. By combining two or more LNCS, food and drink manufacturers can tailor the taste and characteristics of sweetness to the demands of a product and to consumers' tastes *(Miele et al, 2017; McCain et al, 2018)*.

In Europe, the use of LNCS is strictly regulated in the legislation on permitted use of additives under European Union (EU) Regulation 1333/2008 and therefore permitted use depends on the food category or categories into which the product falls *(Regulation (EC), 2008)*.

Low/no calorie sweeteners provide an effective way of reducing sugars content of food products helping the food industry in reformulation efforts

Effective prevention and control of non-communicable diseases (NCDs) require a 'whole-of-society effort'

At the United Nations (UN) General Assembly meeting in September 2011, global leaders committed to responding to the challenge of NCDs with a political declaration which recognised that effective NCDs prevention and control requires a 'whole-of-society effort' through an integrated multi-sectoral approach including the engagement of industry. At subsequent UN High-level Meetings on NCDs in 2014 and 2018, governments took stock of the progress made and re-confirmed their commitment to a coherent, inclusive, multi-stakeholder effort to stem the rise of NCDs. The next High-level Meeting of the United Nations General Assembly will be held in 2025 when the World Health Assembly has settled on a deadline for a set of nine voluntary global targets for the prevention and control of NCDs.

Industry was called upon to contribute to reducing NCDs risk factors and creating health-promoting environments by **"reformulating products to provide healthier options"**. **In seeking to support this global public health objective through product reformulation, LNCS are critical ingredients to help achieve products with less sugars and fewer/zero calories, while still being palatable to consumers.** This has allowed the food industry to respond with innovation and product development and to bring to the market less energy-dense foods and drinks. To sustain and scale up these efforts, LNCS have a key role to play in providing the consumer with wider choice and in creating healthier food environments.

Sources:
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3. United Nations High-Level Meeting on Prevention and Control of Non-communicable Diseases, 2018. Political declaration of the third high-level meeting of the General Assembly on the prevention and control of non-communicable diseases. New York: United Nations General Assembly; 2018 (Document A/73/L.2). Available at: https://digitallibrary.un.org/record/1645265 (Accessed 6 June 2023)
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The role of low/no calorie sweeteners in reducing the intake of free sugars

Low/no calorie sweetened products can help individuals replace sugar-sweetened foods and drinks in their diet and, hence, reduce free sugars intake in line with public health recommendations (*SACN, 2015; WHO, 2015; EFSA, 2022*). Research confirms the beneficial role of LNCS use in sugars intake reduction. A systematic review by the World Health Organization (WHO) found that, as assessed in meta-analyses of randomised controlled trials (RCTs), LNCS intake resulted in a reduction in sugars intake of approximately 39 grams per day (*Rios-Leyvraz and Montez, 2022*). The same study showed that LNCS use led to a significant reduction of total energy intake by almost 134 kcal per day.

Several observational studies have also reported that LNCS consumption is associated with lower dietary sugars intake (*Drewnowski and Rehm, 2014; Hedrick et al, 2015; Gibson et al, 2016; Hedrick et al, 2017; Leahy et al, 2017; Patel et al, 2018; Silva-Monteiro et al, 2018; Barraj et al, 2019; Fulgoni and Drewnowski, 2022*). These findings confirm that low/no calorie sweetened foods and drinks can play a useful role in helping individuals to reduce their free sugars intake in the context of public health recommendations and nutritional guidelines.

Furthermore, in Europe, the use of LNCS in a food or beverage, in almost all cases, must also result in a product that has a total energy reduction of at least 30% according to European Union (EU) Regulation 1333/2008 on food additives (Regulation (EC), 2008). For consumers, this can mean a significant calorie saving, which may be especially helpful in managing overall energy balance.

Low/no calorie sweeteners can help us reduce sugars and energy (calorie) intakes, in line with public health recommendations

LNCS CAN HELP IN REDUCING TOTAL DAILY SUGARS AND ENERGY INTAKES

(REDUCTION OF ~39G SUGARS AND ~134 KCAL PER DAY)

Source: As assessed in meta-analyses of RCTs in the WHO systematic review by Rios-Leyvraz and Montez, 2022

Sugar-swaps and calorie savings

By using LNCS in place of caloric sweeteners and by swapping a sugar-sweetened food or drink with its low/no calorie sweetened equivalent, we can remove both sugars and energy (calories) from a variety of foods and drinks. For example, by adding table-top sweeteners instead of sugars in beverages, we can "save" approximately 4 g of sugars and 16 kcal for each teaspoon of added sugars. Similarly, by switching to a diet/light/zero sugar soft drink, which contains less than 1 kcal, we can reduce energy intake by around 100 kcal per glass (or 140 kcal per can of 330ml) as compared to the regular (sugar-sweetened) product. More examples of calorie- and sugar-saving swaps are provided in Table 1.

Click here for Table 1

By **adding table-top sweeteners** instead of table sugar in our coffee or tea, we can "save" approximately 16-20 calories and 4-5g of sugar for each teaspoon of added sugar.

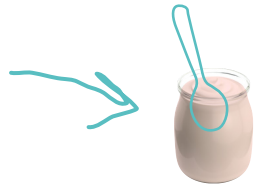
By **switching to a diet/light/zero soft drink** from the sugar-sweetened version, we can "save" approximately 100 calories per glass (250ml) and about 25g of sugar.

By **choosing a low-fat fruit yogurt** with low calorie sweeteners instead of the sugar-sweetened version, we can "save" about 50 calories and about 10g of sugar per portion (200g).

Sugar-sweetened products			Low/no calorie sweetened products		
Type of product	Energy (kcal)	Sugars (g)	Type of product	Energy (kcal)	Sugars (g)
1 teaspoon (4 g) of sugar (white, brown)	16	4	Table-top sweeteners	1	0
1 glass (250 ml) of sugar-sweetened cola-type soft drink	100	25	1 glass (250 ml) of diet/ light/ zero cola-type soft drink	<1	0
1 glass (250 ml) of iced tea drink with sugar	60	15	1 glass (250 ml) of iced tea drink with sugar	<5	0-1
1 portion (200 g) of low fat (1%) fruit yogurt with sugar	160	25	1 portion of low fat fruit yogurt with LNCS (200 g)	110	15
1 large scoop (100 g) of vanilla ice cream with sugar (full fat)	170	22	1 large scoop (100 g) of vanilla ice cream with LNCS (full fat)	120	8
A serving of raspberry jelly with sugar	80	20	A serving of raspberry jelly with LNCS	10	2
1 tablespoon (20 g) of jam with sugar	40-50	10-12	1 tablespoon of jam with LNCS	10-20	2-5
1 tablespoon (17 g) of ketchup with sugar	16	4	1 tablespoon of ketchup with LNCS	7	1
1 piece of chewing gum with sugar	10	2,5	1 piece of chewing gum with LNCS	<5	0
1 piece of hard candy with sugar	25	4	1 piece of hard candy with LNCS	10	0

Source: U.S. Department of Agriculture, Agricultural Research Service. FoodData Central, 2019. fdc.nal.usda.gov.

Table 1: Calorie and sugars content in sugar-sweetened versus comparable low/no calorie sweetened products (on average or range of values).



Low/no calorie sweeteners in sugar reduction: A public health perspective...

Prof Alison Gallagher: Current public health recommendations are that we limit our dietary intakes of free sugars. Free sugars are those added to food or those naturally present in honey, syrups and unsweetened fruit juices, but do not include naturally occurring sugars in milk and milk products. The potential negative impact of high consumption of free sugars on health, particularly from sugar-sweetened beverages, is well recognised being associated with increased weight gain (and thus contributing to obesity), increased risk of developing type 2 diabetes and increased incidence of tooth decay. The World Health Organization (WHO) recommends that we reduce our intakes of free sugars across the life course, recommending that adults and children limited their intake of free sugars to 10% of total energy intake (*WHO, 2015*). In the UK, the Scientific Advisory Committee on Nutrition (SACN) recommends intakes of free sugars should not exceed 5% of total energy intake (*SACN, 2015*). Given the current high consumption of free sugars within the population (in the UK average intakes are estimated to be over double the recommended), achieving such reductions in sugar intakes is challenging and requires targeted approaches including the promotion of healthier choices, reductions in portion size and product reformulations.

LNCS provide a desired sweet taste without the addition of appreciable energy and can help maintain the palatability of reformulated products. All LNCS undergo rigorous safety evaluations prior to their approval for use, usually resulting in the assignment of an acceptable daily intake (ADI) and we can be confident about the safety of LNCS currently approved for use in foods and beverages; indeed, recent global intake data highlight no cause for concern in relation to current LNCS intakes (Martyn et al, 2018). When used to replace sugar-sweetened products with LNCS alternatives, LNCS represent an easy way to reduce dietary intake of sugars. For example, replacing a regular (sugar-sweetened) product with a LNCS equivalent results in a reduction in sugar and energy intake. When used in this way, LNCS have the advantage of reducing energy intake without reducing the palatability (or sweetness) of the diet. Reformulating a beverage to reduce its sugars content is a relatively straight-forward. However, reformulating a food product can be more challenging since the sugars may be present in the food matrix not only for sweetness and palatability, but also for its functional properties. LNCS continue to represent a useful part of efforts to reduce overall intakes of sugars and help with body weight management.

Sugar reduction policies: The UK example

In the United Kingdom, a structured and monitored sugar reduction programme was launched in 2016 with an objective for all sectors of the food industry to voluntarily reduce sugar by 20% by 2020 across the top categories of food that contribute most to intakes of children up to the age of 18 years.

The role of LNCS use in food and beverage reformulation efforts to help the industry achieve sugar reductions was pointed out in evidence reviews and technical reports by Public Health England (PHE) (*PHE, 2017*). The PHE technical report "Sugar Reduction: Achieving the 20%" outlined guidelines for the industry endorsing the European Food Safety Authority's (EFSA) scientific opinion on LNCS and stated that: "Sweeteners that have been approved through EFSA's processes are a safe and acceptable alternative to using sugar and it is up to businesses if and how they wish to use them" (*PHE, 2017*). In reviewing the scientific evidence for sugar reduction, PHE also recognised that replacing foods and drinks sweetened with sugars with those containing LNCS could be useful in helping people to manage their weight as they reduce the calorie content of foods and drinks while maintaining a sweet taste (*PHE, 2015*).

A final progress report between 2015 and 2020 showed mixed progress across different sectors and food categories indicating significant reductions in sugar content in drinks and in specific food categories in retailers and manufacturer branded products (e.g., yogurts, fromage frais, breakfast cereals, ice cream, lollies and sorbets, sweet spreads and sauces), while less progress was reported for the out of home sector (*OHIC, 2022*). Compared with a baseline year of 2015 or 2017, larger sugar content reductions (reductions in sales weighted average sugar per 100ml) were reported for various drink categories, especially for soft drinks (-46%), pre-packed milk based drinks (-29,7%), milkshake powders, syrups and pods as consumed (-34.2%), coffee and tea powders, syrups and pods as consumed (-20.3%), fermented yogurt drinks (-7.1%), and flavoured milk substitute drinks (-6.9%), while reductions for pre-packed juice categories were smaller.

In 2022, WHO Europe launched a new, voluntary, Member State led Sugar and Calorie Reduction Network to promote healthier diets as well as reduce overweight and obesity levels across the WHO European Region, which will be led by the UK Department of Health and Social Care (DHSC) and its Office for Health Improvement and Disparities (OHID) for the first 3-year term, bringing forward the UK's extensive experience in addressing sugar intake at the national level (*WHO/Europe, 2022*).

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4. WHO/Europe. News Release. WHO/Europe to launch new sugar and calorie reduction initiative led by the United Kingdom. Published 20 January 2022. Available at: https://www.who.int/europe/news/item/20-01-2022-who-europe-to-launch-new-sugar-and-calorie-reduction-initiative-led-by-the-united-kingdom (Accessed 6 June 2023)

Role of low/no calorie sweeteners in a healthy diet

Healthy dietary patterns encourage the consumption of a variety of vegetables and fruits, nuts and pulses, whole grains, lean protein foods with emphasis on plant-based sources, and vegetable oils, while emphasising the importance of limiting intakes of foods high in saturated fats, salt, and sugars. Limiting intake of free sugars to less than 10% of total energy intake is part of a healthy diet, as indicated by strong scientific evidence *(WHO, 2015)*. **LNCS and products containing them can support individuals in meeting recommendations to reduce excessive sugars consumption, as part of an overall healthy diet and lifestyle.**

The consumption of LNCS has been linked to improved diet quality in several observational studies examining the dietary habits of different populations around the world *(Duffey and Popkin, 2006; Sánchez-Villegas et al, 2009; Naja et al, 2011; Drewnowski and Rehm, 2014; Hedrick et al, 2015; Gibson et al, 2016; Hedrick et al, 2017; Leahy et al, 2017; Patel et al, 2018; Silva-Monteiro et al, 2018; Barraj et al, 2019; Fulgoni and Drewnowski, 2022)*.

In the first study that examined the health habits of LNCS consumers, Drewnowski and Rehm used data from the National Health and Nutrition Examination Survey (NHANES) collected between 1999 and 2008 from more than 22,000 US citizens *(Drewnowski and Rehm, 2014)*. The researchers reviewed the participants' diets using the Healthy Eating Index, a USDA tool to compare an individual's diet to the Dietary Guidelines for Americans, and found that LNCS consumers had much higher scores on the index than those who did not consume LNCS. Consumers of LNCS reported similar energy intakes but higher intakes of fruits, vegetables, calcium and magnesium, as well as lower intakes of fat, added sugars, and saturated fats, compared to non-consumers. So, overall, LNCS consumers had a better diet quality as illustrated in Figure 2. The same study also showed that individuals who consumed LNCS were less likely to smoke and tended to be more physically active. In all, this was the first study indicating that LNCS consumption was correlated with an overall healthier diet and lifestyle.

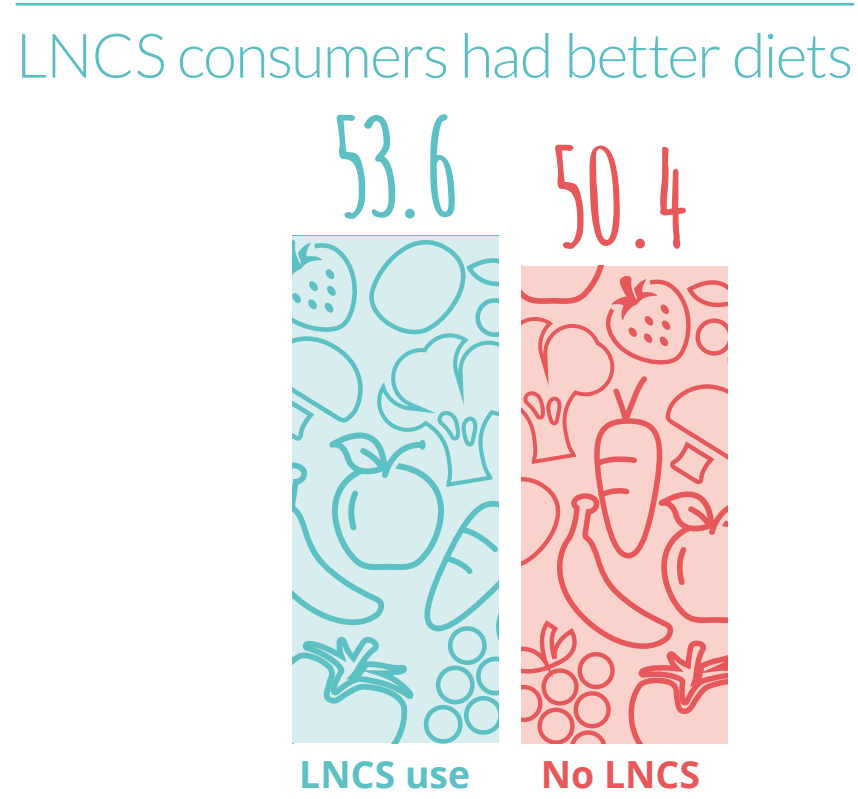
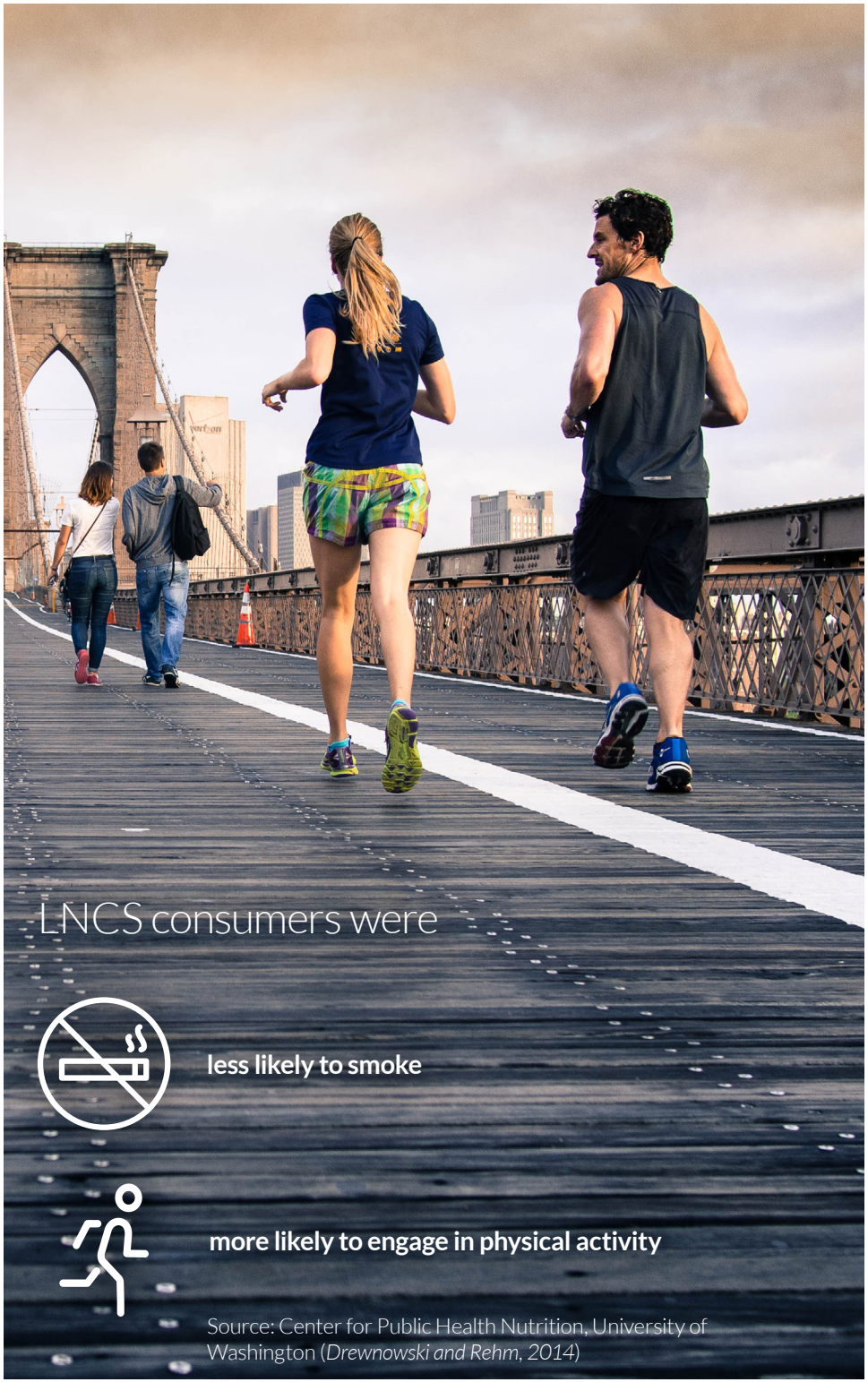


Figure 2: Healthy Eating Index in consumers of low/no calorie sweeteners (LNCS) vs. non-consumers. (*Drewnowski and Rehm, 2014*)
Source: Center for Public Health Nutrition, University of Washington



These findings were later confirmed in US studies by Leahy et al (2017), Barraj et al (2019) and Fulgoni and Drewnowski (2022) who used data from more recent NHANES cycles. Leahy and colleagues found that higher consumption of low/no calorie sweetened drinks was associated with significantly lower intakes of total and added sugars (*NHANES 2001–2012; n=25,817*) (*Leahy et al, 2017*). Barraj and colleagues showed that, across all life stages, consumers of low/no calorie sweetened beverages had higher diet quality and lower intakes of total and added sugars when compared to consumers of sugar-sweetened beverages (SSBs) (*NHANES 2009-2016; n=32,959*) (*Barraj et al, 2019*). More recently, Fulgoni and Drewnowski (2022) also reported that LNCS consumers had higher diet quality and were less likely to smoke, indicating an overall healthier lifestyle (*NHANES 1999-2018; n=48,754*). Interestingly, a study of randomised controlled design in a US sample of rural Virginian adults found similar results: LNCS consumers had significantly higher overall dietary quality than non-consumers, as assessed via the Healthy Eating Index (*Hedrick et al, 2017*).

Similarly, two UK studies that examined data from the UK National Diet and Nutrition Survey (NDNS) found that consumers of LNCS beverages had a better diet quality compared to consumers of SSBs *(Gibson et al, 2016; Patel et al, 2018)*. Gibson and colleagues found that the LNCS group had higher fish, fruits and vegetables intake, and lower meat, fat and saturated fat as well as lower sugar and energy intake, compared to SSBs consumers *(Gibson et al, 2016)*. These findings were confirmed in a subsequent analysis of NDNS data (data collected 2008-2012 and 2013-2014) in a larger sample of 5,521 British adults *(Patel et al, 2018)*. Patel and colleagues found that consumers of low/no calorie sweetened beverages had lower total and free sugars intake and an overall better diet quality, compared to consumers of SSBs *(Patel et al, 2018)*. The study also found that consumers of LNCS beverages were more likely to meet UK recommendations for free sugars' intake, compared to consumers of SSBs *(Patel et al, 2018)*.

Similar findings have also been reported in population studies from other countries *(Sánchez-Villegas et al, 2009; Naja et al, 2011; Hedrick et al, 2015; Silva-Monteiro et al, 2018)*. For example, in a study analysing data of 32,749 individuals participating in the nationally representative Brazilian National Dietary Survey (data collected 2008–2009), it was shown that the mean daily energy intake of participants using table-top sugar (sucrose) was approximately 16% higher compared with those who used LNCS-containing table-top LNCS (Silva-Monteiro et al, 2018). On average, the use of table-top sugar to sweeten foods and beverages was accompanied by an increase of 186 kcal daily compared with the use of table-top LNCS, which corresponded to a 10% increase in total energy intake. Furthermore, individuals who reported exclusive use of sweeteners to sweeten their foods and drinks had also lower consumption of SSBs, sweets and desserts, and higher consumption of vegetables and fruits, compared to those who used sugar, indicating a dietary pattern of higher quality for LNCS users.

Consumers of low/no calorie sweetened foods and drinks tend to have higher quality diets with less sugar-containing food products

Recommendations about the use of low/no calorie sweeteners as part of a healthy diet

The recommendation to limit the excess intake of free or added sugars in the diet is based on strong evidence and therefore supported by health organisations and public health authorities worldwide (*SACN, 2015; WHO, 2015; EFSA, 2022*). **LNCS can be safely used to replace and help reduce dietary sugars as part of a healthy eating plan, as confirmed by food safety bodies globally** (See Chapter 2). This is also reflected in Food-Based Dietary Guidelines (FBDG) and position statements of health and nutrition organisations around the world.

The benefit of replacing added sugars with LNCS in reducing energy intake in the short-term and aiding in weight management was supported by the US Dietary Guidelines for Americans, 2020-2025 (*USDA, 2020*) based on the results of a systematic review and the recommendation by the US Dietary Guidelines Advisory Committee (*DGAC, 2020*). Similarly, the UK dietary guidelines "The Eatwell Guide" recognised that by replacing sugary foods and beverages with LNCS options, people can reduce sugar intake while still keep enjoying the desired sweet taste in their diet. As such, LNCS can play a helpful role in individuals' efforts to keep their daily free sugars intake below the recommended level of 5-10% of total energy intake (*PHE, 2016*).

The role of LNCS in dietary sugars and energy reduction and, hence, their potential benefit in weight control and the nutritional management of diabetes has also been acknowledged by numerous health and nutrition organisations, including the Academy of Nutrition and Dietetics in the United States *(Fitch et al, 2012; Franz et al, 2017)*; the American Diabetes Association *(Gardner et al, 2012; Evert et al, 2019; ElSayed et al, 2023)*, and the American Heart Association *(Gardner et al, 2012; Johnson et al, 2018)*, the British Dietetic Association (BDA, 2016) and Diabetes UK *(Diabetes UK, 2018; Dyson et al, 2018)*, the Diabetes and Nutrition Study Group (DNSG) of the European Association for the Study of Diabetes (EASD) (DNSG-EASD, 2023), the Latin-American Association of Diabetes *(Laviada-Molina et al, 2018)*, the Mexican Societies of Cardiology and of Nutrition and Endocrinology *(Alexanderson-Rosas et al, 2017; Laviada-Molina et al, 2017)*, and Obesity Canada *(Brown et al, 2022)*, among others.

Contrary to these recommendations of clinical practice guidelines for the nutritional management of obesity and diabetes by multiple organisations around the world, a recent WHO guideline on the use on non-sugar sweeteners suggested that they should not be used as a means of achieving weight control or reducing risk of noncommunicable diseases issuing a **conditional** (or else "weak") recommendation (*WHO, 2023*). Conclusions were largely based on low certainty evidence from observational studies which are at high risk of reverse causation and are discussed in detail in the next Chapter (see Chapter 4). Importantly, the recommendation is not supported by the results of the WHO systematic review and meta-analyses of RCTs, which showed that the use of LNCS leads to reduced sugars and energy intakes, and in turn to modest weight loss without affecting cardiometabolic risk factors *(Rios-Leyvraz and Montez, 2022)*. Finally, WHO has not examined whether implementing this conditional recommendation suggesting against LCNS use could lead to undesirable effects, such as to increased sugars intake and associated health outcomes.

The evidence supporting the benefits of LNCS is discussed in detail in the next chapters of this booklet (Chapter 4 – Low/no calorie sweeteners and weight control; Chapter 5 – Low/no calorie sweeteners, diabetes and cardiometabolic health; Chapter 6 – Low/no calorie sweeteners and oral health).

"Conditional recommendations are those recommendations for which the WHO guideline development group is less certain that the desirable consequences of implementing the recommendation outweigh the undesirable consequences or when the anticipated net benefits are very small. Therefore, substantive discussion amongst policy-makers may be required before a conditional recommendation can be adopted as policy." (WHO, 2023)

Conclusion

Enjoying the food we eat while aiming for a healthier diet is key for sustainable, long-term dietary changes. Strategies aimed at improving diet quality should also consider the sensory pleasure response to foods. However, reducing sugars intake may sometimes go against the latter. In this context, **LNCS can help reduce excess intake of dietary sugars while still keeping the enjoyment of sweet taste in the diet as part of an overall healthy dietary pattern.**

LNCS can provide a means to help reduce energy and sugars intake and be a useful dietary tool to people with weight management LNCS can provide a means to help reduce energy and sugars intake and be a useful dietary tool for dental health, and to people with weight management problems or those living with diabetes, as discussed in the next three Chapters.

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