

Quantitative recommendation on sugar intake in Germany

Short version of the consensus paper by the German Obesity Society (DAG), German Diabetes Society (DDG) and German Nutrition Society (DGE)

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Abstract

High and frequent sugar intake is, among others, linked to overweight and obesity, an increased risk for several diseases associated with overweight, such as type 2 diabetes mellitus and cardiovascular diseases, as well as the development of dental caries. Accordingly, various international scientific and official government bodies have already published quantitative recommendations on daily sugar intake. Recent data show that the population-level intake of sugars in Germany significantly exceeds these recommendations. With the consensus paper, the German Obesity Society (DAG), the German Diabetes Society (DDG), and the German Nutrition Society (DGE) are endorsing the recommendation of the World Health Organization (WHO) from 2015 and call for a maximum free sugar intake of no more than 10% of total energy intake. Free sugars include mono- and disaccharides which manufacturers, cooks or consumers add to foods, plus sugars naturally present in honey, syrups, fruit concentrates, and fruit juices. In case of an estimated total energy intake of 2,000 kcal per day, this recommendation corresponds to 50 g free sugars. Currently, various policies to promote healthy diets are applied across the world to reduce sugar intake. In the long term a coordinated combination of a range of mandatory policies to promote healthy diets is recommendable. This means to address the food environment and food system with a comprehensive strategy to deal with the multicausal problem of overweight and obesity and the associated conditions caused partly by unhealthy eating. This article represents the short version of the consensus paper.

Keywords: sugar, free sugars, added sugars, sugar intake, WHO, public health

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Introduction and goals

A high and frequent sugar intake is associated with various undesirable health consequences. Some consequences, such as the development of dental caries, relate to sugar intake directly and within a short time frame, whereas others are of an indirect nature and their development is more complex.

For this reason, various international scientific and official government bodies have published quantitative recommendations on sugar intake. Sugar intake in Germany is currently considerably above these recommendations. Therefore, a clear definition for a maximum level of sugar intake with no detrimental health consequences is needed. The European Food Safety Authority (EFSA) was requested by the Nordic countries to update their report from 2010 due to the additional data available [1], but this update is not to be expected before 2020 at the earliest.

The aim of the consensus paper by the German Obesity Society (DAG), German Diabetes Society (DDG), and German Nutrition Society (DGE) [2] is to present the existing quantitative recommendations for the daily intake of added and free sugars, respectively, given by other scientific and official government bodies and to establish a quantitative recommendation on daily sugar intake applicable for the general population in Germany. Furthermore, policies to promote healthy diets focussing on the reduction of sugar intake are presented and corresponding recommendations for action established. This paper represents the short version of the consensus paper [2].

Sugar definitions in international use

In the current discussion on sugars, besides the term total sugars, two further terms in particular have become established internationally; namely “added sugars” and “free sugars” (♦ Table 1). The key distinction between added and free sugars is the exclusion or inclusion of some naturally occurring sugars in foods, particularly sugars from fruit juices. Mono- and disaccharides naturally occurring in whole fruits, vegetables and dairy foods are excluded from both definitions [3]. This consensus paper refers to free sugars in accordance with the WHO definition (♦ Table 1) [4].

Estimated sugar intake in Germany

Currently, estimates of free sugar intake are mainly based on self-assessments of participants in corresponding nutrition surveys. The requested data on food consumption can be used to calculate sugar intake with the help of the German Nutrient Database (*Bundeslebensmittelschlüssel*, BLS).

The average daily intake of free sugars by adolescents and adults between 15 and 80 years in Germany were calculated using data from the German National Nutrition Survey II (*Nationale Verzehrsstudie II*, NVS II) [8] (♦ Table 2A). Adolescents aged between 15 and 18 years and young adults aged between 19 to 24 years proved to have the highest intake of free sugars and for this reason they are shown separately. Intake of free sugars decreased steadily with increasing age. For women and men between the ages of 15 and 80 years the energy percentages are 13.9 En% and 13.0 En%, respectively [9].

Full version of the consensus paper:
 → www.dge.de/fileadmin/public/doc/ws/stellungnahme/Konsensuspapier_Zucker_DAG_DDG_DGE_2018.pdf

In the course of the DONALD study¹ (Dortmund Nutritional and Anthropometric Longitudinally Designed Study) the daily intake of free sugars (including vegetable juices, fruit juice spritzers and smoothies) was established for children and adolescents between 3 and 18 years [10] (♦ Table 2B). It was shown that over time the intake of free and added sugars, as well as total sugar intake slightly decreased in 3–18 year olds since 2005 and significantly decreased since 2010 [11]. The intake of free sugars is however still significantly above 10 En% for all population groups (♦ Tables 2A/2B)

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Scientific body/official govt. body	Term	Definition
WHO/FAO, 1998 [5]	<i>total sugars</i>	Total sugars include all mono- and disaccharides in the diet regardless of their source.
EFSA, 2010 [6]	<i>added sugars</i>	Added sugars refer to sucrose, fructose, glucose, starch hydrolysates (glucose syrup, high-fructose syrup) and other isolated sugar preparations used as such or added during food preparation and manufacturing.
USDA, 2015 [7]	<i>added sugars</i>	Added sugars are sugars that are either added during the processing of foods, or are packaged as such. They include sugars (free, mono- and disaccharides), syrups, naturally occurring sugars that are isolated from a whole food and concentrated so that sugar is the primary component (e.g. fruit juice concentrates), and other caloric sweeteners.
WHO, 2015 [4]	<i>free sugars</i>	Free sugars include monosaccharides (glucose, fructose, galactose) and disaccharides (saccharose, lactose, maltose, trehalose) added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices, and fruit juice concentrates.

Tab. 1: Internationally established sugar definitions of selected scientific and official government bodies

EFSA = European Food Safety Authority; FAO = Food and Agriculture Organization; USDA = United States Department of Agriculture; WHO = World Health Organization

Free sugars (En%) ^a			
Age	15–80 years	15–18 years	19–24 years
Women	13.9	17.8	18.5
Men	13.0	17.4	16.2

Tab. 2A: Estimated intake of free sugars by women and men according to NVS II, expressed as a percentage of total energy intake

^a according to WHO definition (2015) in [4]

En% = energy percentage; NVS II = German National Nutrition Survey II

Free sugars (En%) ^a				
Age	3–5 years	6–10 years	11–14 years	15–18 years
Girls	16.3	17.5	16.7	15.2
Boys	16.9	17.0	16.9	15.8

Tab. 2B: Estimated intake of free sugars by girls and boys according to the DONALD study, expressed as a percentage of total energy intake

^a according to WHO definition (2015) in [4] incl. vegetable juices, fruit juice spritzers, and smoothies

DONALD study = Dortmund Nutritional and Anthropometric Longitudinally Designed Study; En% = energy percentage

Sugar content in food

Sugar is not only used to sweeten foods, it also fulfills various functions in processed foods. It contributes (partially in very small quantities) for instance to stabilisation and preservation, maintenance of freshness and moisture content, adjustment of texture, consistency and colour, and general refinement of aroma [12]. Free sugars are thus not only commonly found in confectionery and sugar-sweetened beverages, but also in savoury sauces and convenience foods. Processed foods with high sugar content are often foods with a high energy and low nutrient density, since they generally contain high levels of fat, low levels of water, dietary fiber, and essential nutrients, too [13]. However, foods with low energy and high essential nutrient density can also be rich in sugars, which in these cases are naturally present [14].

Examples of foods and beverages with naturally occurring sugars

Typical examples of foods with natural occurring sugars are fruits and vegetables as well as unsweetened milk and milk products [15]. Fruits with high sugar content are, for instance, bananas (17 g/100 g), grapes (15 g/100 g), mirabelles (14 g/100 g), and apples (13 g/100 g). Examples of vegetables containing natural occurring sugars are beetroot (8 g/100 g) and carrots (6 g/100 g). A 100 ml portion of cow's milk contains approx. 5 g of

lactose. The natural occurring sugars contained in these foods are not considered as free sugars according to the definition (full version chapter 2 [2]).

Examples of food and beverages rich in (free) sugars

Within processed foods, as to be expected, confectioneries contain a high content of free sugars. In Germany, the most important contributor to free sugars intake is confectionery with 36% [8]. According to the BLS, jelly sweets contain 75 g of sugar, foam sugar goods 80 g of sugar, and plain cake 23 g of sugar per 100 g, for example [15].

According to these data from the Max Rubner-Institute (MRI) fruit juices and nectars make up an additional 26% and soft drinks another 12% of free sugar intake [8]. Corresponding to the sugar content of the whole fruits, the fruit juices made from them, such as grape juice or apple juice, are also rich in natural occurring sugars (11–17 g/100 ml). Whilst 100 ml of fruit nectar contains 17 g of sugar, 100 ml of lemonade or cola contains 10–11 g of sugar. Thus, just one portion of a sugary beverage (200 ml) is equivalent to an intake of 20 to 34 g of free sugars [15].

Processed foods, which one would not necessarily expect to have high sugar contents, can also contain very high levels of sugar. In addition, there can be considerable differences in the levels of total sugar content (without distinction between natural occurring and added sugars) within the same product group, like (sweetened) milk products or breakfast cereals. According to analyses by the MRI the sugar content of ready-to-eat fruit yoghurt varied between 4 and 22 g (average [av.]: 13.7 g) per 100 g, muesli between 0.8 and 33.7 g (av.: 16.0 g) per 100 g, and breakfast cereals between 1.5 and 35 g (av.: 16.4 g) per 100 g [8]. The sugar content in most foods designed for children, such as breakfast cereals for children, was on average almost twice as high with contents between 14.9 and 43 g (av.: 29.2 g) per 100 g.

Exposure	Scientific body/official government body	Country	Target group	Quantitative recommendation	Explanation/reason
Added sugars	IOM (Institute of Medicine), 2005 [20]	USA	general population	≤ 25 En%	decreased intake of some micronutrients when exceeding this level
	NNR (Nordic Council of Ministers), 2012 [21]	Nordic Countries ^a	general population	< 10 En%	nutrient displacement, dental caries, type 2 diabetes mellitus (SSB), overweight (SSB)
	DGAC (Dietary Guidelines Advisory Committee), 2015 [22]	USA	general population	< 10 En%	nutrient displacement, weight gain, type 2 diabetes mellitus (SSB)
	AHA (American Heart Association), 2016 [23]	USA	children infants	≤ 25 g avoid added sugars	cardiovascular disease risk, excess energy intake, obesity, dyslipidemia
Free sugars	ESPGHAN (European Society for Paediatric Gastroenterology, Hepatology, and Nutrition), 2017 [24]	Europe	children and adolescents, infants	< 5 En% (≥ 2 to 18 years) lower for < 2 years	weight gain, dental caries, type 2 diabetes mellitus (SSB), cardiovascular disease risk
	WHO (World Health Organization), 2015 [4]	global	general population	< 10 En% (<i>strong</i>) < 5 En% (<i>conditional</i>)	weight gain, dental caries
	SACN (Scientific Advisory Committee on Nutrition), 2015 [25]	Great Britain	general population (≥ 2 years)	≤ 5 En%	excess energy intake, dental caries, weight gain (SSB, children), type 2 diabetes mellitus (SSB)
Total sugars (excluding lactose and galactose from milk and milk products)	ANSES (French Agency for Food, Environmental and Occupational Health & Safety), 2016 [26]	France	adults	< 100 g	energy intake, weight gain, effects on triglyceride levels (fructose)

Tab. 3: Quantitative recommendations on daily sugar intake by scientific and official government bodies

^a Denmark, Iceland, Finland, Norway, Sweden

En% = energy percentage; SSB = sugar-sweetened beverages

Declaration of sugar in Germany

In Germany food declarations must be in line with the provisions of Regulation (EU) No 1169/2011 of the European Parliament on the provision of food information to consumers (*Lebensmittelinformationsverordnung*; LMIV) [16]. This mandatory declaration of nutrition information on pre-packaged processed foods contains information on the content of energy and of fat (of which saturated fatty acids), carbohydrates (of which sugars), protein, and salt. The nutrition information should be given per 100 g or 100 ml. This ensures easy comparison between

various products. The nutritional information “of which sugars” relates to the total sugar content of the food, thus the sum of natural occurring sugars contained in the food plus sugars added to the product, i.e. all mono- and disaccharides contained in the product [16]. A separate declaration for the content of free or added sugars is not a requirement in Germany, yet. However, added sugars must be listed as an ingredient in the ingredient list of pre-packaged food. It is important to note that there are more than 50 different terms for sweetening ingredients. Therefore, they are not immediately recognisable for the consumer [17]. In the list of ingredients, all ingredients are shown in descending order of their proportional weight. Thus, the main ingredient is first on the list and the ingredient with the lowest proportional weight is at the end of the list [18]. If no type of sugar is included in the list of ingredients it means that no sugar

Level	Goal	Behavioural change through...	Measure (selection)	Examples
Measures to support decision-making	informed selection	improved decision-making	improved market transparency definition of health and environmental claims advertising restrictions and bans	restrict food advertising and other forms of commercial promotion regarding foods designed for children
	easier selection	simplification of behavioural changes	standards for (“front of package”) labelling, government labels, design of interpretative labels, and warning labels	stop label, keyhole label, Nutri-Score, traffic light labeling
Measures to influence decision-making	guided selection through changed standards	reformulation of foods nudging changed standards	maximum levels of certain ingredients (e.g. salt, sugar) prominent placement of healthy products in displays, attractive product design, etc.	national reduction strategy for sugar, fat, and salt in convenience foods nudging in communal catering implementation of DGE quality standards for communal catering
	guided selection through positive incentives	positive incentives	subsidies, bonus programmes	tax reduction on beverages below a sugar content boundary
	guided selection through negative incentives	negative incentives	taxes, charges	taxes on sugar-sweetened beverages
Measures to limit decision-making	limited selection through product exclusion	exclusion of undesirable products	ban on supply	deliberate avoidance of sugar-sweetened beverages in specific settings such as schools

Tab. 4: Selection of policy measures to promote healthy diets focussing on reduced sugar intake (mod. in line with [49, 50])

has been added to the product; but it may still have a very high sugar content (e.g. from added fruit preparations).

other hand, they arise from differences in the exposure examined, i.e. the underlying definition of sugar (added sugars vs. free sugars vs. total sugars) [19].

Quantitative recommendations on sugar intake

The aim of the quantitative recommendations for daily sugar intake, which have been published in recent years by various international scientific and official government bodies, is to reduce sugar intake (♦ Table 3). Despite the fact that quantitative recommendations are identical, a large variation in the underlying methodology and justifications can be observed. On the one hand, differences in the methods used to derive these recommendations arise from the assessment of different discussed health consequences or outcomes used (i.e. dental caries, weight gain due to positive energy balance, nutrient displacement). On the

Quantitative recommendation on sugar intake: joint consensus of DAG, DDG and DGE

Various international scientific and official government bodies have classified the existing data as sufficiently robust to derive a quantitative recommendation on sugar intake (▣▣▣ full version chapter 6 [2]). The consumption data presented show that sugar intake in Germany significantly exceeds these quantitative recommendations, particularly in the younger age groups. According to data from the German health interview and examination survey for adults (DEGS 1) 29% of women and 43.8% of men are affected by pre-obesity (defined as BMI ≥ 25–29.9), and 23.9% and 23.3% by obesity (defined as BMI ≥ 30), respectively [27]. According to current data from the German Health Interview and Examination Survey for Children and Adolescents (KiGGS wave 2) 15.4% of 3 to 17 year olds were overweight and 5.9% were obese [28]. There were no significant differences between girls and boys.

Obesity is associated with numerous comorbidities, including type 2 diabetes mellitus, dyslipoproteinemia, cardiovascular diseases, cancer, fatty liver, and degenerative joint diseases. With the associated annual direct and indirect costs of at least EUR 13 billion (2003), obesity and its comorbidities represent a major burden for the national health system [29]. The direct costs of the comorbidities arising from high and frequent sugar intake of mono- and disaccharides were estimated to be EUR 8.6 billion in Germany in the year 2008 [30]. With regard to the national prevalence of overweight and the goal of reducing the disease burden of obesity and its associated comorbidities and directly associated conditions, such as dental caries, it is essential that the possible consequences of high and frequent sugar intake and thus high total energy intake are highlighted and a reduction of sugar intake is recommended. A population-wide reduction of sugar intake can contribute to an improved diet and thus a more health promoting lifestyle.

In contrast to added sugars, the definition of free sugars also includes fruit juices. With a per capita consumption of 32 litres per annum in 2017, Germany is one of the top consumers of fruit juices and nectars compared to other European countries [31, 32]. Together with all other refreshing beverages (116 litres/head/annum; incl. lemonades and colas) consumption of these drink categories was as high as the consumption of bottled water (148 litres/head/annum) in 2017 [31]. Although consumption of fruit juices in Germany has declined slightly since 2015, large quantities of sugars are still consumed purely by the consumption of beverages in Germany.

Sugar molecules cannot be distinguished chemically by their source. Therefore, the fructose naturally occurring in an apple or in apple juice is identical with the fructose in glucose-fructose syrup, which, for instance, is used to sweeten sugary beverages. Nevertheless, the physiological effects of chemically identical sugars can be different depending on the food matrix in which the sugars are found and consumed, e.g. whether the sugar source is a solid or liquid food [3].

In particular, a high intake of sugary beverages can lead to a positive energy balance and as a result to a higher body weight and increased risk of several diseases [25, 33, 34]. The DGE also concluded as early as 2011 that there was probable evidence that an increased intake of sugar-sweetened beverages increases

the risk of obesity in adults and the risk of type 2 diabetes mellitus [35]. Whilst the consumption of solid foods is compensated by adapting the consumption of other foods, there is inadequate compensation of the energy intake when beverages are consumed. Insufficient satiation supports an increased total energy intake in the case of an ad libitum diet [36–39]. The increased risk of type 2 diabetes mellitus associated with a higher consumption of sugar-sweetened beverages persisted even after adjustment for energy intake [40, 41]. Moreover, a high-sugar diet can lead to displacement of foods rich in essential nutrients and thus to reduced diet quality [14, 42, 43]. Sugary foods and beverages often deliver a lot of energy due to their high sugar content, but generally contain little or no essential nutrients.

Due to the particular role played by sugary beverages, their high consumption per capita in Germany, the high national prevalence of overweight and obesity, and the associated disease burden, the DAG, DDG, and DGE endorse the evidence-based WHO recommendation from 2015 (strong recommendation).

According to this the intake of free sugars should be reduced to less than 10% of total energy intake [4]. According to the definition of free sugars this also includes naturally occurring sugars from honey, syrups, fruit juices and fruit juice concentrates.

In case of an estimated total energy intake of 2,000 kcal per day this recommendation corresponds to a maximum intake of 50 g free sugars (1 g sugar = 4 kcal). The quantitative recommendation endorsed in the consensus paper is not to be understood as a recommended intake based on average requirements, but is to be seen as a maximum upper limit.

The evidence-based guideline of the DGE on carbohydrate intake and prevention of nutrition-related diseases has shown that the quality of carbohydrate intake is important for primary prevention of nutrition-related diseases [35]. Accordingly, in case of an isoenergetic diet, attention should be paid particular to the type of carbohydrates consumed with foods. In general the DGE recommends a wholesome and varied diet. It should be made up mainly of plant-based foods like vegetables, fruits, and wholegrain products with only few processed foods [44]. Avoidance of sugary foods and highly processed foods can help to reduce the intake of free sugars. Consumption of sugary beverages should be avoided and should be replaced by water or unsweetened teas. Generally sugar should be used sparingly [35, 44]. Children should not become accustomed to a high sugar intake. Therefore, if possible, foods specially advertised for children with a high sugar content should be avoided. [45].

Policy measures to promote healthy diets focusing on reduced sugar intake

In Germany, efforts to improve diet and health in the population focus particularly on nutrition education, e.g. by providing information and numerous initiatives to increase exercise. However, experience up to

now has shown that behavioural prevention measures to encourage a healthy lifestyle at population level have not led to the desired reduction of overweight or obesity and the associated nutrition-related diseases [46].

More promising public health interventions in the classic sense rely on preventive measures addressing the food environment and food system, i.e. they specifically target conditions in the living environment. In an environment with unlimited access to fattening foods, it should be made easier for the consumer to make healthy choices (“Make the healthy choice the easy choice” [47]). The implementation of preventive measures addressing the food environment and food system is appropriate where there is i) a need to act at population level, ii) prospect of benefit, and iii) lack of useful alternatives likely to lead to success [48]. Globally, various policies to promote healthy diets by reducing sugar intake have already been implemented (♦ Table 4). A more detailed presentation of these policies can be found in the full version of the consensus paper [2].

Summary and resulting recommendations for action

High and frequent sugar intake is associated with overweight and obesity, various nutrition-related comorbidities, and the development of dental caries. Various international scientific and official government bodies have evaluated the scientific research data as sufficiently robust to give a quantitative recommendation on daily sugar intake.

In Germany, the intake of free sugars significantly exceeds existing intake recommendations, especially in younger age groups. With their consensus paper [2], the DAG, DDG, and DGE endorse the WHO recommendation of 2015, stating that the intake of free sugars should be limited to less than 10% of total energy intake [4]. Free sugars include mono- and disaccharides added to foods by manufacturers, cooks, or consumers, as well as naturally occurring sugars in honey, syrups, fruit juices, and fruit concentrates. In general, attention should be paid to the quality of carbohydrates consumed. Ultra-processed and sweetened foods should be rarely consumed and sugar containing beverages should be replaced with water or unsweetened teas. In order to avoid an exceedance of the recom-

mended intake of free sugars, mean current intake must be reduced by at least 25% at population level.

Experience up to now has shown that behavioural prevention to promote a healthy diet and improve health conditions in Germany is not sufficient to reduce the prevalence of overweight and obesity and nutrition-related diseases at population level [46]. The German government is currently implementing the National Reduction and Innovation Strategy for Sugars, Fats, and Salt in Convenience Foods (*Nationale Reduktions- und Innovationsstrategie für Zucker, Fette und Salz in Fertigprodukten*) as a measure to promote healthy diets by changing the food environment in Germany. The essential preconditions for success of this measure are to set specific, time-bound target marks, consistent evaluation through independent monitoring, scientific support by independent experts or scientific bodies, and publication of regular progress reports. On a global scale, various policies to promote healthy diets by reducing sugar intake have already been implemented. In the long term, as demanded by various scientific bodies and expert groups [24, 47, 50–54], a coordinated combination of mandatory measures within the context of a holistic approach is needed to face the complexity of dietary and health problems at population level and to achieve a notable change in health-relevant parameters.

Conflict of Interest

Prof. de Zwaan is member of the scientific advisory council of the Institute Danone and has received attendance fees.

Prof. Hauner has received consultancy fees from the companies Danone, Nestlé and MedScape within the past 3 years as well as a salary for a lecture paid by the company Rettenmeyer & Söhne.

Prof. Buyken is member of the International Carbohydrate Quality Consortium (ICQC) and of the ILSI Europe Carbohydrates Task Force.

The remaining authors declare no conflict of interest.

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