

# Prevention of Obesity among Adults: Evidence- and Consensus-Based Guideline

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## Keywords

Obesity · Prevention · Guideline · Evidence-based approaches · Consensus-based process

## Abstract

**Background:** The prevalence of obesity is rising globally. Evidence-informed guidance on preventing obesity is needed, but most existing obesity guidelines are focussed on treatment. **Methods:** We developed an evidence- and consensus-based guideline on the prevention of obesity among adults. Following international best practice recommendations for guideline development, we systematically searched for relevant systematic reviews and conducted a structured consensus process involving

34 experts including 5 patient representatives. The guideline's target group is the adult population of Germany, but most recommendations are likely to be applicable internationally. **Results:** We developed 24 recommendations for the general public, health care professionals, and policy makers. The guideline recommends, among others, a healthy diet in line with existing food-based dietary guidelines, regular physical activity, as well as appropriate sleep and stress management. Smoking cessation is recommended even when associated with weight gain. Offering qualified advice and counselling on diet and physical activity to all individuals in primary care is suggested. Potential effects of medication on body weight should be considered in prescription decisions. Implementation of evidence-informed policies for

promoting healthy food and physical activity environments is recommended. **Conclusions:** Evidence-based approaches for preventing obesity on the individual and societal levels exist and should be implemented more widely.

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## Introduction

Obesity is a major medical and public health problem globally [1]. Obesity is associated with an increased risk for a number of other chronic diseases, including type 2 diabetes mellitus, cardiovascular disease, musculoskeletal conditions, and depression [1]. It can negatively affect quality of life [2] and is responsible for substantial health care and societal costs [3]. In some countries, the prevalence of obesity has stabilized over the past decades in some population groups (including children and high-income adults) [4]. However, no country world wide has managed to halt or even reverse the trend towards rising levels of obesity in the general adult population [4]. While there have been advances in the treatment of obesity, most treatment options are resource intensive and not available to all patients [5]. Preventing obesity is therefore a key public health challenge [4].

A number of factors have been implicated in the global obesity epidemic, including changes to food environments (such as an increased availability of energy-dense foods and beverages) and physical activity patterns (such as a decrease in work-related physical activity and active transport) [6, 7]. It is generally recognized that obesity requires a multi-level response, including interventions on the individual, community, and population level [8]. For this reason, integrated clinical and public health guidelines on the prevention of obesity have been called for [9]. However, most existing obesity guidelines are either focussed on the management (or treatment) of obesity [10–12], have not been developed through a systematic process of assessing evidence and establishing expert consensus [13–15], are focussed on children [16–18], or are limited to certain topics (such as the use of non-nutritive sweeteners, or counselling in primary care) [19–21].

Against this backdrop, the German Obesity Society initiated the development of a multidisciplinary, evidence- and consensus-based guideline on the prevention and management of obesity, following international best practice recommendations for guideline development [22–24]. In the present paper, we report on the recommendations for the prevention of obesity.

## Methods

### Overview

This is an evidence- and consensus-based guideline. We used a systematic, structured approach to ground the recommendations on the best available evidence, as well as formal procedures to consider the views and to find consensus among relevant experts and stakeholders. We followed the methodological guidance of the Association of the Scientific Medical Societies in Germany (AWMF) [25], which is based on the AGREE II tool and the Guidelines International Network (GIN) McMaster guideline development checklist [22–24], which are considered the international gold standard for conducting and reporting clinical practice guidelines. The following sections provide an overview of our methodology. Further details are presented in the online supplementary material (available at <https://doi.org/10.1159/000546415>).

### Scope and Purpose

The overarching objective of the parts of the guideline presented here was to contribute to the prevention of obesity in adults, defined in line with WHO criteria as a BMI equal to or above 30 [26]. While the guideline's main focus is primary prevention (defined as preventing the development of obesity among individuals without obesity), most of its recommendations will also be relevant for secondary prevention (i.e., preventing further weight gain among individuals living with obesity). Recommendations on the treatment of obesity (i.e., measures aimed primarily at achieving weight loss and managing the consequences of obesity among individuals with obesity) will be published separately [27].

### Outcomes

The guideline committee considered a number of outcomes to assess the effects of interventions and exposures (see online suppl. material). The primary outcome was anthropometric measures (e.g., body weight and composition, BMI, overweight, and obesity). Further key outcomes considered were quality of life and potential adverse outcomes and unintended consequences (e.g., stigmatization and self-stigmatization and nutrient deficiencies arising from inadequate dietary intake).

### Population

The guideline was developed for the German adult population as the primary target population. However, most recommendations are likely to be relevant for

**Table 1.** PICO criteria for the literature search

| PICO item         | Description                                                                                               |
|-------------------|-----------------------------------------------------------------------------------------------------------|
| P (population)    | Adults in high-income countries, excluding pregnant women and individuals with specific health conditions |
| I (interventions) | Interventions to prevent obesity on the individual, setting, or population level                          |
| C (comparison)    | No or different intervention                                                                              |
| O (outcome)       | Anthropometric measures                                                                                   |

populations in high-income countries in general. Children as well as pregnant women are covered in separate guidelines [18, 28]. Some of the recommendations in this guideline may not apply to individuals with underweight, dietary restrictions, restricted mobility, or other specific conditions.

*Stakeholder Involvement*

The guideline committee had 34 members, including 29 representatives of 14 medical and scientific societies and professional associations based in Germany (including, among others, the German Obesity Society, the German Nutrition Society, and the German Association for Sports Medicine and Prevention), as well as 5 representatives of 3 organizations representing patients living with obesity. A full list of members of the guideline committee is included in the online supplementary material. The views and preferences of the target population were sought through the patient representatives and the practical experience of the committee members. The target audience of the guideline are health professionals, policy makers, and the general public.

*Search Methods and Evidence Selection*

To inform the guideline, we systematically searched for relevant systematic reviews and existing guidelines. We conducted a systematic search in MEDLINE and targeted searches of the Cochrane Library and in the guideline registry of the Guidelines International Network (GIN). We undertook additional targeted searches in MEDLINE on questions related to specific recommendations. The systematic search was conducted in June and July 2020, and a targeted search update was conducted in March 2024. The overarching PICO criteria guiding our evidence selection are shown in Table 1. A detailed description of our search methods and selection criteria is provided in the online supplementary material.

*Grading of Evidence and Recommendations*

We used GRADE to assess the certainty of evidence [29], using published GRADE assessments from existing high-quality systematic reviews and guidelines. To rate the strength of recommendations, we used the AWMF's four-level system (see Table 2), using the certainty of the evidence and balance of benefits and harms as rating criteria [25]. Recommendations for which no GRADE assessments were available were classified as Good Clinical Practice (GCP).

*Formulation of Recommendations*

Recommendations were formulated through an iterative process weighing benefits and harms, the certainty of the evidence, and feasibility and acceptability as main criteria. Initial suggestions for recommendations and accompanying texts presenting relevant evidence and rationales were drafted by a working group of committee members based on the initial search, existing guidelines, and their own expert experience. These preliminary recommendations were subsequently revised and refined through discussions among members of the working group including the patient representatives, targeted literature searches for evidence on specific recommendations, an online consultation, and a preliminary online vote among all committee members. The final recommendations were discussed and approved in structured online consensus conferences with neutral moderation and a formal voting among committee members. Agreement of above 75% was set as threshold for a consensus and >95% for a strong consensus.

**Results**

*Overview of Recommendations*

We formulated 24 recommendations, covering dietary behaviours, physical activity, sedentary behaviour, sleep, stress, smoking cessation, behavioural counselling in health care settings, use of medication, and policy-level interventions. Table 3 provides an overview. The rationale of each recommendation and further details are provided below.

Recommendations on Nutrition

**1. We recommend following a balanced diet adapted to individual requirements (evidence: high; recommendation: A; consensus: 100%)**

Numerous studies have examined the influence of dietary intake on body weight. In systematic reviews

**Table 2.** System for rating the strength of recommendations

| Rating | Description and syntax used                                                                                                                                                            |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A      | Strong recommendation (“we recommend/we recommend not to”)                                                                                                                             |
| B      | Recommendation (“we suggest/we suggest not to”)                                                                                                                                        |
| 0      | Open recommendation (“may be considered/may be avoided”)                                                                                                                               |
| GCP    | Good clinical practice/clinical consensus (recommendation or statement based on expert consensus or evidence not assessed for its certainty, with varying strengths of recommendation) |

reviewed for this guideline, the following foods and dietary patterns were associated with a lower body weight and/or a lower risk for overweight and obesity: vegetables [56], fruit [56], legumes [56], whole grain products [31, 56], fibre [31], energy-restricted dietary patterns with low carbohydrate, low fat, or balanced macronutrient content [33], healthy vegetarian and vegan diets [101], healthy Mediterranean diets [102], and the Dietary Approaches to Stop Hypertension diet [103]. Foods and dietary components that were associated with a higher body weight and/or a higher risk for overweight and obesity included ultra-processed foods [43], refined grains [56], sugar-sweetened beverages (SSB) [32, 35], and free sugars [32, 35]. Besides effects on obesity risk, diets can influence the risk for a variety of other chronic diseases, must fulfil nutrient requirements, and be practically feasible and culturally acceptable in a given context. These considerations inform the development of evidence-based dietary guidelines and recommendations, including those published by the WHO [104], the Dietary Guidelines for Americans [49], the Nordic Nutrition Recommendations [105], and the food-based dietary guidelines of the German Nutrition Society [106], among others. These guidelines generally recommend foods that are associated with a reduced risk of obesity and discourage foods that are associated with an increased risk of obesity [49, 50, 104, 105]. For the prevention of obesity, the present guideline therefore recommends to follow a balanced diet adapted to individual nutrient requirements in line with existing evidence-based dietary guidelines.

**2. We recommend avoiding extremely restricted diets (GCP; consensus: 94%)**

Extremely restricted diets propagated for the prevention of unwanted weight gain include completely fat-free or carbohydrate-free diets and diets based exclusively

or almost exclusively on one or a small number of food groups, such as fruit, fruit juices, rice, eggs, or raw vegetables [107]. Such diets may cause nutrient deficiencies, may be difficult to sustain in the long run, and may not be associated with health gains even when contributing to short-term weight control [14]. The present guideline therefore recommends against such diets.

**3. When a diet without any animal-derived foods is chosen for weight control purposes, we suggest following the recommendations on vegan diets of the German Nutrition Society (GCP; consensus: 94%)**

Research suggests that vegan diets are associated with a lower body weight and a lower risk of obesity and may contribute to preventing excess weight gain [40, 108, 109]. On the other hand, vegan diets can be associated with an insufficient intake of critical nutrients, in particular vitamin B12, but also essential amino acids, long-chain *n*-3 fatty acids (EPA and DHA), other vitamins (riboflavin, vitamin D, vitamin A), and minerals (calcium, iodine, iron, selenium, and zinc) [42]. The German Nutrition Society therefore recommends, among others, that individuals practicing a vegan diet should take vitamin B12 supplements, have their vitamin B12 status checked regularly, and seek and follow qualified advice to ensure a sufficient intake of critical nutrients [42]. The present guideline suggests that this guidance is followed when vegan diets are practiced for the prevention of obesity.

**4. We suggest limiting the consumption of ultra-processed foods with a high energy density (GCP; consensus: 100%)**

A number of systematic reviews show that regular consumption of ultra-processed foods is associated with weight gain and an increased risk of obesity. A systematic review and meta-analysis of one cohort and 13 cross-sectional studies reported associations between ultra-processed food intake and overweight (odds ratio [OR]: 1.02; 95% confidence interval [CI]: 1.01–1.03, *p* < 0.001) and obesity (OR: 1.26; 95% CI: 1.13–1.41, *p* < 0.001) [43]. In a review of 5 country-wide cross-sectional studies, 3 cohort studies, 2 ecological studies, and 1 RCT, all but one cross-sectional study reported significant positive associations between ultra-processed food consumption and body weight [44]. Moreover, many ultra-processed foods have a high energy density, which may also be associated with increased weight gain [45, 46]. While some fresh or minimally processed foods with a high energy density (such as nuts and seeds, some high-quality vegetable oils, and fatty fish) are recommended by dietary guidelines due to their high content of critical nutrient such as *n*-3 fatty acids and possible health

**Table 3.** Recommendations for the prevention of obesity

| No. | Recommendation                                                                                                                                                                           | Certainty of evidence | Strength of recomm. | Degree of consensus, % | Main references     |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|------------------------|---------------------|
| 1   | We recommend following a balanced diet adapted to individual requirements                                                                                                                | High                  | A                   | 100                    | [30–38]             |
| 2   | We recommend avoiding extremely restricted diets                                                                                                                                         | na                    | GCP                 | 94                     | [14, 39]            |
| 3   | When a diet without any animal-derived foods is chosen for weight control purposes, we suggest following the recommendations on vegan diets of the German Nutrition Society <sup>1</sup> | na                    | GCP                 | 94                     | [40–42]             |
| 4   | We suggest limiting the consumption of ultra-processed foods with a high energy density                                                                                                  | na                    | GCP                 | 100                    | [43–46]             |
| 5a  | We recommend limiting the consumption of beverages with a high sugar content                                                                                                             | High                  | A                   | 94                     | [32]                |
| 5b  | We suggest as beverages preferably water and other non-alcoholic beverages without added sweeteners and a low sugar and calorie content                                                  | na                    | GCP                 | 100                    | [47–50]             |
| 6   | Beverages with non-nutritive sweeteners may be preferred to beverages with added sugars                                                                                                  | Moderate              | 0                   | 94                     | [51–53]             |
| 7   | We suggest limiting the consumption of alcoholic beverages                                                                                                                               | na                    | GCP                 | 100                    | [54, 55]            |
| 8   | We recommend a diet high in fibre                                                                                                                                                        | High                  | A                   | 94                     | [31, 37, 56]        |
| 9   | We suggest limiting the consumption of free sugars to 10% of total energy intake                                                                                                         | Moderate              | B                   | 94                     | [32, 35, 36]        |
| 10a | For the prevention of obesity total energy intake is more important than the share of carbohydrates, fat and protein in total energy intake                                              | Moderate              | Statement           | 100                    | [33, 57, 58]        |
| 10b | We suggest macronutrient needs are met with foods of high overall nutritional value                                                                                                      | na                    | GCP                 | 92                     | [31, 37, 38, 57–59] |
| 10c | The reference intake values of the German Nutrition Society <sup>2</sup> may be used as guidance for the intake of macronutrients                                                        | na                    | GCP                 | 100                    | [60–62]             |
| 11  | Dietary patterns with varying distributions of food intake over the course of the day may be recommended                                                                                 | na                    | GCP                 | 93                     | [63–65]             |
| 12  | We suggest limiting portion sizes                                                                                                                                                        | Moderate              | B                   | 93                     | [66, 67]            |
| 13  | We recommend regular physical activity in daily life, leisure time and work                                                                                                              | Strong <sup>3</sup>   | A                   | 93                     | [68, 69]            |
| 14  | We recommend limiting sedentary behaviour                                                                                                                                                | na                    | GCP                 | 100                    | [69–71]             |
| 15  | Methods for self-monitoring may be considered to increase levels of physical activity                                                                                                    | Low                   | 0                   | 93                     | [72]                |
| 16  | Avoiding a high chronic negative stress burden may be recommended                                                                                                                        | na                    | GCP                 | 100                    | [73–76]             |
| 17  | We suggest ensuring a sufficient length of sleep and a regular sleep pattern                                                                                                             | n.a                   | GCP                 | 93                     | [77, 78]            |
| 18  | We suggest that individuals who notice an unwanted weight gain seek advice from a medical doctor                                                                                         | na                    | GCP                 | 92                     | [15]                |

**Table 3** (continued)

| No. | Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                 | Certainty of evidence | Strength of recomm. | Degree of consensus, % | Main references |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|------------------------|-----------------|
| 19  | The health gains of smoking cessation outweigh the potential negative health consequences of weight gain that may occur after stopping smoking. Smoking cessation is recommended even when associated with weight gain                                                                                                                                                                                                         | na                    | GCP                 | 100                    | [15, 79, 80]    |
| 20  | We recommend against dietary supplements, homeopathic medication and other non-evidence-based methods of weight control                                                                                                                                                                                                                                                                                                        | na                    | GCP                 | 88                     | [81–84]         |
| 21  | We suggest that individuals are offered qualified advice on diet and physical activity in primary care regardless of their weight status                                                                                                                                                                                                                                                                                       | Moderate              | B                   | 77                     | [85, 86]        |
| 22  | For drugs that are associated with relevant weight gain, potential effects on body weight should be considered when the overall balance of the benefits and harms of a prescription is determined. When such a drug is prescribed, patients should be informed that they may gain weight, and options for weight management and, if applicable, alternatives to the prescribed medication should be discussed with the patient | na                    | GCP                 | 93                     | [15, 87–90]     |
| 23  | To prevent obesity on the population level, we suggest implementing evidence-informed measures to contribute to healthy food environments                                                                                                                                                                                                                                                                                      | Moderate              | B                   | 94                     | [34, 91–97]     |
| 24  | To prevent obesity on the population level, we suggest implementing evidence-informed measures to create environments that promote physical activity                                                                                                                                                                                                                                                                           | Low                   | B                   | 100                    | [98–100]        |

GCP, Good Clinical Practice; na, not applicable. <sup>1</sup>These include the advice that individuals practicing a vegan diet should take vitamin B12 supplements, have their vitamin B12 status checked regularly, and seek and follow qualified advice to ensure a sufficient intake of critical nutrients [42]. <sup>2</sup>These include protein: 0.8 g–1.0 per kg body weight; fat: 30–35% of total energy intake; carbohydrates: >50% of total energy intake. For details and exceptions to these rules, see the background section on recommendation 10c [60–62]. <sup>3</sup>Evidence rating based on the Physical Activity Guidelines Advisory Committee (PAGAC) rating system [70].

benefits, this is not the case for ultra-processed foods with a high energy density [49, 50, 105]. Besides, some fresh or minimally processed foods with a high energy density – such as fatty nuts – have been shown not be associated with an increased risk of obesity [110]. The present guideline therefore suggests limiting specifically the consumption of ultra-processed foods with a high energy density.

#### Recommendation on Beverage Consumption

**5a. We recommend limiting the consumption of beverages with a high sugar content (evidence: high; recommendation: A; consensus: 94%)**

**5b. We suggest using preferably water and other non-alcoholic beverages without added sweeteners and**

**a low sugar and calorie content as beverages (GCP; consensus: 100%).**

Numerous studies show that regular consumption of SSB can contribute to weight gain. In a meta-analysis of 6 RCTs for the European Food Safety Authority (EFSA) Panel on Nutrition, a positive association between SSB consumption and body weight was found (+0.82 kg, 95% CI: 0.36–1.29; follow-up 12–72 weeks) [32]. The 10 prospective cohort studies included in the review could not be meta-analysed but consistently reported positive associations between SSB consumption and obesity or abdominal obesity [32]. The certainty of the combined body of evidence from RCTs and cohort studies was judged to be high [32]. Research suggests that beverages in general that have a high sugar and energy

content – including SSB, 100% fruit juice, and sugar-sweetened milk – may increase energy intake and the risk for obesity [47]. 100% fruit juice can be a source of essential micro-nutrients but often has an energy and sugar content similar to that of SSB [48]. The German Nutrition Society therefore recommends to dilute 100% fruit juice with water in a ratio of 1 part juice and 3 parts water [111]. In line with existing dietary guidelines [49, 50], the present guideline recommends to limit the consumption of beverages with a high sugar content and suggests to use for hydration preferably water and other non-alcoholic beverages without added sweeteners and a low sugar and calorie content.

**6. Beverages with non-nutritive sweeteners may be preferred to beverages with added sugars (evidence: moderate; recommendation: 0; consensus: 94%)**

The use of non-nutritive sweeteners for obesity prevention is subject to debate. In RCTs comparing beverages with non-nutritive sweeteners with SSB, the former are generally associated with less weight gain. In a meta-analysis of 12 RCTs with 601 participants and a follow-up between 3 and 39 weeks comparing beverages with non-nutritive sweeteners with SSB, the former were associated with less weight gain (−1.06 kg, 95% CI: −1.71 to −0.41 kg), a lower BMI (−0.32, 95% CI: −0.58 to −0.07), and a lower share of body fat (−0.60%, 95% CI: −1.03% to −0.18%) [51]. The certainty of evidence was judged to be moderate [51]. In a meta-analysis of 9 RCTs with 974 participants comparing beverages with non-nutritive sweeteners with water, no statistically significant differences in anthropometric measures were found (low certainty of evidence) [51]. These results are in line with other recent systematic reviews [52, 53]. On the other hand, concerns have been raised concerning potential negative long-term effects of non-nutritive sweeteners on taste perception, appetite regulation, dietary quality, and health outcomes [112, 113]. The WHO suggests in its guideline on the topic that non-sugar sweeteners not be used as a means of achieving weight control or reducing the risk of non-communicable diseases (conditional recommendation based on low-certainty evidence for potential long-term detrimental effects of non-sugar sweeteners) [19]. Given these concerns, water and other beverages without any caloric or non-nutritive sweeteners may be the safest option until more definitive evidence on the effects of non-nutritive sweeteners becomes available. However, for individuals who do not want to eschew sweetened beverages completely, the potential but not yet conclusively proven adverse effects of non-nutritive sweeteners have to be weighed against the proven adverse health effects of SSB [113]. The

present guideline therefore suggests that in such cases, beverages with non-nutritive sweeteners may be preferred to beverages with added sugars.

**7. We suggest limiting the consumption of alcoholic beverages (GCP; consensus: 100%)**

The evidence on the relationship between alcoholic beverages and obesity is inconclusive. Systematic reviews and meta-analyses have reported positive associations for high but not for low or moderate alcohol intake [54, 55]. In a dose-response meta-analysis of 127 observational studies, high alcohol consumption (defined as >28 g/day) compared to no or low alcohol consumption was associated with an increased risk of overweight (OR: 1.12, 95% CI: 1.01–1.24), overweight and obesity (OR: 1.32, 95% CI: 1.16–1.51), and abdominal obesity (OR: 1.25, 95% CI: 1.12–1.38) [54]. In light of this evidence and the proven other health risks of high alcohol consumption [114, 115], the present guideline suggests limiting the consumption of alcoholic beverages.

**8. We recommend a diet high in fibre (evidence: high; recommendation: A; consensus: 94%)**

Research shows that diets high in fibre are associated with a lower risk for overweight and obesity. In a meta-analysis of 27 RCTs among adults, diets high in fibre compared to diets low in fibre were associated with reduced body weight after adjustment for other factors (−0.37 kg, 95% CI: −0.63 to −0.11; 2,496 participants; follow-up 4 weeks to 18 months; high certainty of evidence) [31]. Foods that are naturally high in fibre, such as vegetables, fruit, legumes, and whole grain products, may also have additional health benefits, including protective effects against overweight and obesity that are independent of their fibre content [31, 56]. In its guideline on carbohydrate intake, WHO recommends for adults a daily intake of at least 25 g of naturally occurring dietary fibre as consumed in foods (strong recommendation based on high-certainty evidence) [37]. The German Nutrition Society recommends a slightly higher intake of at least 30 g/day for adults [57, 116]. The present guideline follows this guidance and recommends a diet high in fibre.

**9. We suggest limiting the consumption of free sugars to 10% of total energy intake (evidence: moderate; recommendation: B; consensus: 94%)**

Studies have shown that a high intake of free sugars can contribute to weight gain and an increased risk for obesity. In the systematic review and meta-analysis conducted for the WHO guidelines on sugar intake, 30 RCTs and 38 cohort studies among adults and children were included. In a meta-analysis of RCTs, reduced sugar intake compared to an ad-libitum diet was associated

with lower weight gain (−0.80 kg, 95% CI: −0.39 to −1.21;  $p < 0.001$ ; follow-up 10 weeks to 8 months; 1,286 participants; 5 RCTs), and increased sugar intake compared to an ad-libitum diet was associated with increased body weight (+0.75 kg, 95% CI: 0.30–1.19;  $p = 0.001$ ; follow-up 2 weeks to 6 months; 10 RCTs with 520 participants) [35]. The certainty of evidence was assessed as moderate [35]. The WHO guideline on sugar intake recommends to limit the consumption of free sugars among adults and children to no more than 10% of total energy intake, noting that limiting it to no more than 5% may bring additional health benefits [36]. The European Food Safety Authority (EFSA) concludes in its scientific opinion on dietary sugars that due to the observed health risks, no safe upper level of intake can be set for added and free sugars and that intake should be as low as possible in the context of a nutritionally adequate diet [32]. The present guideline follows the WHO and the German guidelines on sugar intake in recommending to limit intake of free sugars to less than 10% of total energy intake, or approximately 50 g/day for an average adult with a total energy intake of 2,000 kcal/day [36, 117].

**10a. For the prevention of obesity, total energy intake is more important than the share of carbohydrates, fat, and protein in total energy intake (statement; evidence: moderate; consensus: 100%).**

**10b. We suggest that macronutrient needs are met with foods of high overall nutritional value (GCP; consensus: 92%).**

**10c. The reference intake values of the German Nutrition Society may be used as guidance for the intake of macronutrients (GCP; consensus: 100%).**

The optimal share of different macronutrients (carbohydrates, fat, and protein) in total energy intake is subject to debate. In a systematic review of RCTs on low-calorie diets with varying macronutrient compositions used in weight-loss trials, low-calorie diets with a balanced macronutrient composition, low-fat diets, as well as low-carbohydrate diets were all associated with reduced body weight when compared to regular ad-libitum diets, with slightly larger effects for low-fat and low-carbohydrate diets (mean length of follow-up 26 weeks, 121 RCTs with 21,942 participants) (see Table 4) [33].

This evidence comes from weight-loss trials and may therefore not be directly applicable to the prevention of obesity in the general population [33]. In general, effects of the share of fat and carbohydrates on body weight seem to be driven mainly by effects on total energy intake [57, 58]. The German guidelines on carbohydrate and fat intake therefore conclude that when total energy intake is

controlled for, the share of carbohydrates and fat in total energy intake is probably not associated with the risk for obesity [57, 58]. By contrast, when total energy intake is not controlled for, diets that are high in low-quality carbohydrates (in particular free sugars and refined grains) and fats (in particular from processed foods) are associated with a higher risk for obesity [30, 56–58]. Similarly, a number of fresh and minimally processed foods with a high natural protein content (including legumes and whole grain) are associated with a lower risk for obesity [56]. This suggests that the dietary quality of the sources of macronutrients (i.e., the specific foods consumed) is important in determining effects on body weight. Moreover, effects on body weight are not the only consideration that is relevant for deriving recommendation on macronutrient shares in total energy intake. Other relevant considerations include the compatibility with dietary patterns that are healthy overall and practical under real-world conditions and in the long run for the general population. Such considerations informed the development of the reference intake values for macronutrients of the German Nutrition Society. These allow for a range of different shares of protein, fat, and carbohydrates in total energy intake and account for overall dietary quality and further aspects, such as average physical activity levels (see Table 5) [60].

This guidance is in line with the WHO guidelines on total, saturated and trans-fatty acid, as well as carbohydrate intake [37, 38, 59]. The WHO guidelines on fat intake suggest that to reduce the risk of unhealthy weight gain, adults should limit their total fat intake to 30% of total energy intake or less (conditional recommendation based on high-certainty evidence) and that fat consumed should be primarily unsaturated fatty acids, with no more than 10% of total energy intake coming from saturated fatty acids and no more than 1% of total energy intake coming from trans-fatty acids (strong recommendation based on moderate-certainty evidence) [38, 59]. WHO further recommends replacing saturated fatty acids in the diet with polyunsaturated fatty acids, monounsaturated fatty acids from plant sources, or carbohydrates from foods containing naturally occurring dietary fibre, such as whole grains, vegetables, fruits, and pulses [59]. The WHO guideline on carbohydrate intake recommends that carbohydrate intake should come primarily from whole grains, vegetables, fruits, and pulses (strong recommendation based on moderate-certainty evidence) [37].

In light of this evidence and these considerations, the present guideline concludes that for the prevention of obesity total energy intake is more important than the share of carbohydrates, fat, and protein in total energy

**Table 4.** Effects on body weight of energy-controlled diets with varying macronutrient patterns (121 RCTs with 21,942 participants, evidence from weight-loss trials) [33]

| Comparisons                                                                 | Effects on body weight after 6 months | Certainty of evidence |
|-----------------------------------------------------------------------------|---------------------------------------|-----------------------|
| Low fat versus diet as usual                                                | −4.37 kg (95% CI: −3.03 to −5.74)     | Moderate              |
| Low carbohydrate versus diet as usual                                       | −4.63 kg (95% CI: −3.42 to −5.87)     | Moderate              |
| Low calorie with balanced macronutrient composition versus diet as usual    | −3.06 kg (95% CI: −2.04 to −4.10)     | Moderate              |
| Low fat versus low carbohydrate                                             | +0.26 kg (95% CI: −0.92 to 1.45)      | Moderate              |
| Low fat versus low calorie with balanced macronutrient composition          | −1.31 kg (95% CI: −2.40 to −0.22)     | Low                   |
| Low carbohydrate versus low calorie with balanced macronutrient composition | −1.57 kg (95% CI: −2.29 to −0.86)     | Moderate              |

**Table 5.** Reference intake values and recommendations for macronutrient intake of the German Nutrition Society [60–62]

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Protein       | 0.8 g per kg body weight for adults up to 65 years of age and 1.0 for adults above 65 years (for individuals with overweight or obesity, intake should be based on their normal weight for height); a protein intake of up to twice this reference value is considered safe [118]. For athletes doing >5 h of intensive training per week, an intake of 1.2–2.0 g per kg body weight may be beneficial [61]. During pregnancy and lactation, specific recommendations apply [62]                                                                  |
| Fat           | Up to 30% of total energy intake (among physically active individuals up to 35% of total energy intake); saturated fatty acid intake should be no more than 10% of total energy intake                                                                                                                                                                                                                                                                                                                                                            |
| Carbohydrates | More than 50% of total energy intake; a lower share of carbohydrates and a correspondingly higher share of protein and fat is acceptable when a number of conditions are met (e.g., a sufficiently high intake of whole grain products, fibre, and essential micronutrients and a limited intake of saturated and trans-fatty acids and red and processed meat) [60]. This generally requires that the increased intake of protein and fat comes from healthy foods (preferable plant-based foods like legumes) recommended by dietary guidelines |

intake. Total energy intake should be adapted to individual needs, and attention should be paid to the dietary quality of the source of macronutrients, and higher-quality sources (i.e., foods recommended in evidence-based dietary guidelines) should be preferred over lower-quality sources. As guidance on the intake of macronutrients, the reference intake values of the German Nutrition Society may be used [60].

**11. A variety of temporal eating patterns (i.e., distributions of food intake over the course of the day) may be practiced (GCP; consensus: 93%)**

The timing of food intake is discussed as a potential determinant of body weight and other diet-related health outcomes. Some existing guidelines on the prevention of obesity recommend, for example, to eat breakfast while controlling for total energy intake [14]. A systematic review of the more recent evidence suggests, however, that under real-life conditions, the advice to eat breakfast may be associated with in-

creased energy intake (+259.79 kcal/day, 95% CI: 78.87–440.71, 10 RCTs) and increased body weight (+0.44 kg, 95% CI: 0.07–0.82, 7 RCTs) [63]. Further studies have examined the effect of time-restricted eating (i.e., not eating for defined periods of time each day, typically 12–20 h/day) and intermittent fasting (i.e., repeated fasting for one or several days, such as alternate-day fasting). In short-term trials comparing these forms of fasting to regular ad-libitum diets, they were associated with reduced energy intake and body weight [64, 65]. It is, however, unclear if they confer relevant net long-term benefits over balanced, energy-controlled diets without time restrictions [64, 65]. The present guideline therefore concludes that the currently available evidence is not sufficient to recommend a specific temporal eating pattern and that a variety of temporal eating patterns (i.e., distributions of food intake over the course of the day) may be practiced according to personal preferences.

**12. We suggest limiting portion sizes (evidence: moderate; recommendation: B; consensus: 93%)**

Research suggests that smaller portion sizes are associated with lower total energy intake, which may reduce the risk for obesity. A Cochrane review found small to moderate effects of portion, package, or tableware size on food intake (standardized mean difference: 0.38, 95% CI: 0.29–0.46; 58 RCTs with 6,603 participants) [66]. The certainty of evidence was assessed as moderate [66]. Another systematic review found that smaller portion sizes may be associated with lower body weight (−0.6 kg, 95% CI: −0.8 to −0.4; 4 RCTs with 245 participants; follow-up 4 days to 6 months) [67]. The present guideline therefore suggests limiting portion sizes.

Recommendations on Physical Activity

**13. We recommend regular physical activity in daily life, leisure time, and work (evidence: strong [PAGAC]; recommendation: A; consensus: 93%)**

Studies show that regular physical activity can reduce the risk for obesity. A systematic review for the US physical activity guidelines concluded on the basis of 42 cohort studies and 2 RCTs that there is strong evidence that regular moderate- to high-intensity physical activity reduces the risk for weight gain [68]. For low-intensity physical activity, no statistically significant associations with weight gain were reported. No threshold for relevant effects on body weight could be established due to inconclusive evidence, but estimates range from a minimum of 60 min/week of high-intensity physical activity to a minimum of 150–300 min/week moderate-intensity physical activity [68]. The current WHO guidelines on physical activity note that among adults aged 18–64 years measures of adiposity may improve with physical activity [69]. However, the WHO guidelines base their recommendations primarily on evidence for effects of physical activity on all-cause mortality, cardiovascular mortality, and incident type 2 diabetes mellitus, the certainty of which was assessed as moderate [69]. In light of this evidence, the present guideline recommends regular physical activity in daily life, leisure time, and work.

**14. We recommend limiting sedentary behaviour (GCP; consensus: 100%)**

The evidence on the effects of sedentary behaviour on weight status is inconclusive. A review of reviews for the US physical activity guidelines identified two systematic reviews with 10 included studies each [70, 71]. Based on these, the authors conclude that limited evidence suggests a positive relationship between greater time spent in sedentary behaviour and higher levels of adiposity and indicators of weight status [70, 71]. The WHO guidelines

on physical activity and sedentary behaviour found moderate-certainty evidence for effects of sedentary behaviour on all-cause and cardiovascular mortality but not for measures of adiposity or body weight [69]. In light of potential positive effects on body weight, and demonstrated positive effects on a variety of other relevant health outcomes, the present guideline recommends limiting sedentary behaviour.

**15. Methods for self-monitoring may be used to increase levels of physical activity (evidence: low; recommendation: 0; consensus: 93%)**

Limited evidence suggests that methods for self-monitoring, including physical activity logs and pedometers, may help to increase physical activity levels. In particular, a Cochrane review found low-certainty evidence for effects of pedometers on daily step counts [72]. The present guideline therefore suggests that such techniques may be used to increase levels of physical activity.

Recommendations on Other Behaviours

**16. Avoiding a high chronic negative stress burden may be recommended (GCP; consensus: 100%)**

A number of studies suggest that a high level of chronic negative stress may be associated with an increased risk for obesity [73–76]. In light of this evidence and the demonstrated adverse effects of chronic negative stress on a number of other health outcomes, the present guideline concludes that it may be recommended to avoid a high chronic negative stress burden.

**17. We suggest ensuring a sufficient length of sleep and a regular sleep pattern (GCP; consensus: 93%)**

There is limited evidence suggesting that chronic sleep deprivation may increase the risk for obesity [77, 78]. The present guideline therefore suggests ensuring a sufficient length of sleep and a regular sleep pattern.

**18. We suggest that individuals who notice unwanted weight gain seek advice from a medical doctor (GCP; consensus: 92%)**

Unwanted weight gain may be a symptom of specific treatable and potentially serious conditions (e.g., hypothyroidism), or a side effect of medication. Besides, timely behavioural counselling may help to limit further weight gain. The present guideline therefore recommends that individuals who observe in themselves unwanted weight gain seek advice from a medical doctor.

**19. The health gains of smoking cessation outweigh the potential negative health consequences of weight gain that may occur after stopping smoking. Smoking cessation is recommended even when associated with weight gain. (GCP; consensus: 100%)**

Smoking cessation can be associated with weight gain [79]. However, meta-analyses suggest that for all-cause mortality, the benefits of stopping smoking outweigh the negative effects of a potential weight gain [79], and the same is likely to be true for most other relevant health outcomes. The present guideline therefore follows the Canadian and other existing obesity guidelines in recommending smoking cessation even when associated with weight gain [15].

Weight gain after smoking cessation may increase the risk of a relapse and is associated with further health risks. A Cochrane review examined interventions to prevent weight gain after smoking cessation. It found moderate-certainty evidence that nicotine replacement therapy may limit weight gain, but the observed effect size was small ( $-0.23$  kg, 95% CI:  $-0.53$  to  $0.06$ ; 14 RCTs with 2,566 participants) [80]. Low-certainty evidence suggests that physical activity programs may have a small or no effect on weight gain until the end of treatment ( $-0.25$  kg, 95% CI:  $-0.78$  to  $0.29$ ; 4 RCTs with 404 participants) but may have a larger effect at 12 months follow-up ( $-2.07$  kg, 95% CI:  $-3.78$  to  $-0.36$ ; 3 RCTs with 182 participants) [80]. Evidence for other interventions to reduce weight gain after smoking cessation was limited [80].

**20. We recommend against dietary supplements, homeopathic medication and other non-evidence-based methods of weight control (GCP; consensus: 88%)**

Numerous dietary supplements, homeopathic medications, and other non-evidence-based methods are advertised as means to prevent weight gain, or to lose weight. The available evidence suggests that these methods generally do not confer a net benefit. A systematic review of 25 primary studies and 5 existing reviews identified 11 dietary supplements marketed for weight control [81]. Relevant effects on body weight were reported only for one product (*Ephedra sinica*), which can have dangerous side effects and which has therefore been banned from sale in a number of jurisdictions, including the US and several European countries [119, 120]. Another review of reviews similarly concluded that the existing literature fails to provide good evidence that dietary supplements for weight control generate clinically relevant effects without undue risks [82]. One systematic review examined homeopathic medications and other complementary therapies [83]. Two of the included studies suggested small positive effects of hypnotherapy in combination with cognitive behavioural therapy and for hypnotherapy for stress reduction. For all other methods, no convincing evidence suggesting effectiveness was identified [83]. A

systematic review focussed on adverse events of herbal food supplements for body weight reduction concluded that for most of the reviewed supplements, the reported risks were sufficient to shift the risk-benefit balance against their use [84]. The Canadian obesity guideline found a lack of evidence for over-the-counter commercial weight-loss products for obesity management, and therefore does not recommend their use [12]. In light of these considerations, the present guideline recommends against dietary supplements, homeopathic medication, and other non-evidence-based methods of weight control. Dietary supplements may, however, be warranted for other reasons, e.g., in case of demonstrated micronutrient deficiencies or in specific patient groups, e.g., after bariatric surgery, during pregnancy, or in individuals following a vegan diet.

Recommendations for Health Professionals

**21. We suggest that individuals are offered qualified advice on diet and physical activity in primary care regardless of their weight status (evidence: moderate; recommendation: B; consensus: 77%)**

Two systematic reviews for the US Preventive Services Task Force (USPSTF) examined the effects of primary-care relevant behavioural interventions targeting diet, physical activity, and sedentary behaviour among adults with or without cardiovascular risk factors (including individuals with normal weight, overweight, or obesity) [85, 86]. This included low-intensity interventions (such as provision of information material) as well as higher-intensity interventions (including individual counselling and group counselling with individual follow-up) [85, 86]. In the meta-analysis, effects on BMI, body weight, waist circumference, dietary and physical activity behaviours, as well as intermediate cardiovascular risk factors were found (see Table 6) [85, 86]. Among adults with known cardiovascular risk factors, interventions also reduced the risk for cardiovascular events [86]. The present guideline therefore suggests that individuals are offered qualified advice on diet and physical activity in primary care regardless of their weight status.

**22. For drugs that are associated with relevant weight gain, potential effects on body weight should be considered when the overall balance of the benefits and harms of a prescription is determined. When such a drug is prescribed, patients should be informed that they may gain weight, and options for weight management and, if applicable, alternatives to the prescribed medication should be discussed with the patient (GCP; consensus: 93%)**

**Table 6.** Effects of primary-care relevant behavioural interventions targeting diet, physical activity, and sedentary behaviour in individuals with normal weight, overweight, or obesity [21, 85, 86, 121]

| Patient group                                         | Evidence base                                                                  | Effects on body weight <sup>1</sup>                                                                                                                               | Certainty of evidence <sup>2</sup> |
|-------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Patients with existing cardiovascular risk factors    | Meta-analysis of 94 RCTs with 52,174 participants, follow-up 12–24 months [86] | BMI: −0.5 kg/m <sup>2</sup> (95% CI: −0.7 to −0.3)<br>Body weight: −1.6 kg (95% CI: −2.1 to −1.1)<br>Waist circumference: −1.7 cm (95% CI: −2.4 to −1.1)          | Moderate [21]                      |
| Patients without existing cardiovascular risk factors | Meta-analysis of 34 RCTs with >75,000 participants, follow-up 6–12 months [85] | BMI: −0.41 kg/m <sup>2</sup> (95% CI: −0.62 to −0.19)<br>Body weight: −1.04 kg (95% CI: −1.56 to −0.51)<br>Waist circumference: −1.19 cm (95% CI: −1.79 to −0.59) | Moderate [121]                     |

<sup>1</sup>The number of studies and participants included in the meta-analyses varied by outcome. <sup>2</sup>Refers to the certainty of beneficial effects overall, not the certainty of the precise values for specific outcomes.

A number of commonly used drugs are associated with weight gain. This includes, among others, certain antipsychotics and antidepressants, glucocorticoids, insulin, beta-blockers, lithium, and certain cancer treatments [15, 87]. For contraceptives, a Cochrane review found limited, low-certainty evidence that progestin-only contraceptives may be associated with weight gain, but the effect size was considered to be small by the review authors (less than 2 kg at 6–12 months in most studies) [88]. A Cochrane review on combination contraceptives (containing oestrogen and progestin) concluded that the available evidence was insufficient to determine the effect of combination contraceptives on weight but that no large effect was evident [89]. A further Cochrane review found low-certainty evidence that metformin may be effective in limiting antipsychotic-induced weight gain [90], and the German schizophrenia guideline concludes that metformin may be considered for this indication as second-line treatment after behavioural and psychosocial support interventions, while considering the risks of polypharmacy [122]. The present guideline recommends that for drugs that are associated with relevant weight gain, potential effects on body weight should be considered when the overall balance of the benefits and harms of a prescription is determined. When such a drug is prescribed, patients should be informed that they may gain weight and options for weight management and, if applicable, alternatives to the prescribed medication should be discussed with the patient.

Policy Recommendations

**23. To prevent obesity on the population level, we suggest implementing evidence-informed measures to contribute to healthy food environments (evidence: moderate; recommendation: B; consensus: 94%)**

Dietary behaviour is strongly influenced by environmental factors, including the availability, accessibility, marketing, and price of different foods and beverages. The modern food environment, characterized by a predominance of energy-dense, nutrient-poor ultra-processed foods and beverages, is considered to be a key driver of the global obesity pandemic [6, 7]. Measures targeting the food environment are therefore essential for effective obesity prevention on the population level. The NOURISHING framework distinguishes six food environment-related policy areas in which governments and other actors can take action to improve population-level nutrition (see Table 7) [123]. Such population-level interventions are often more difficult to evaluate with RCTs, and assessments of the certainty of evidence with instruments such as GRADE often yield lower ratings than for individual-level interventions [134]. Available GRADE ratings from published systematic reviews suggest moderate to very low certainty evidence, depending on intervention and context. To realize substantial effects on a population level, comprehensive strategies combining multiple interventions (policy packages) may be needed.

In its guideline on fiscal policies to promote healthy diets, WHO recommends implementation of policies to

**Table 7.** Policies for supporting healthy food environments (based on the NOURISHING Framework) [123]

| Policy area                                                                          | Examples and selected references                                                                                              |
|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Nutritional labelling and regulation of health claims                                | Nutrition labels to influence consumer choices [34, 94] and to incentivize reformulation [124]                                |
| Nutrition standards for public institutions and other settings                       | School nutrition standards [125] and fruit provision schemes in schools [126]                                                 |
| Fiscal instruments                                                                   | Taxes and subsidies on SSB and other foods [127, 128]                                                                         |
| Regulation of food marketing                                                         | Regulation of advertisement for unhealthy foods directed at children [129], marketing restrictions in specific settings [130] |
| Measures to improve the nutritional quality of the whole food supply (reformulation) | Programmes to reduce sodium and trans-fats in processed foods [131, 132]                                                      |
| Incentives and rules for retail and food service                                     | Measures to reduce package and portion sizes [66], healthy checkouts in supermarkets [133]                                    |

tax SSB (strong recommendation based on moderate-certainty evidence), to tax foods that do not contribute to a healthy diet, and to subsidize foods that contribute to a healthy diet (conditional recommendation based on very low-certainty evidence) [135]. The WHO guideline on policies to protect children from the harmful impact of food marketing suggests implementation of policies to restrict marketing of foods high in saturated fatty acids, trans-fatty acids, free sugars, and/or salt to which children are exposed and that such policies (i) be mandatory; (ii) protect children of all ages; (iii) use a government-led nutrient profile model to classify foods to be restricted from marketing; (iv) be sufficiently comprehensive to minimize the risk of migration of marketing to other media, to other spaces within the same medium, or to other age groups; (v) restrict the power of food marketing to persuade (conditional recommendation based on very low-certainty evidence) [136]. In light of these considerations, the present guideline suggests that to prevent obesity on the population level, evidence-informed measures to contribute to healthy food environments are implemented.

**24. To prevent obesity on the population level, we suggest implementing evidence-informed measures to create environments that promote physical activity (evidence: low; recommendation: B; consensus: 100%)**

Physical activity levels are influenced by environmental factors, including the availability, attractiveness, and safety of different forms of recreational, transport-, and work-related forms of physical activity [137]. The WHO Global Action Plan on Physical Activity 2018–2030 recommends a number of policy

actions to create physical and social environments that promote physical activity, including measures to promote cycling, walking and public transport use, improved access to green and recreational spaces and sports facilities, and best-practice communication, education, and training activities (see Table 8) [138]. As for population-level nutrition policies, the evidence for the effectiveness of relevant interventions varies and may be dependent on context and quality of implementation. Policy action may therefore be informed by context-specific analyses, such as national physical activity action plans and recommendations. To prevent obesity on the population level, we suggest implementing evidence-informed measures to create environments that promote physical activity.

**Discussion**

*Summary of Main Findings*

We used an evidence- and consensus-based process in line with international best practice recommendations for guideline development to derive 24 recommendations for the prevention of obesity. On the individual level, we recommend a healthy diet in line with existing food-based dietary guidelines, regular physical activity and limits to sedentary time, and proper sleep and stress management. We recommend against extremely unbalanced and restrictive diets (such as zero-fat or zero-carb diets, or diets based on a very limited range of foods). We also recommend against using dietary supplements and homeopathic medicine for weight control purposes. Smoking cessation is recommended even when associated with weight gain. We

**Table 8.** Policy actions recommended by the WHO Global Action Plan on Physical Activity [138]

| Strategic objective | Policy actions (examples)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Active societies    | Best-practice communication campaigns<br>Regular mass participation initiatives in public spaces<br>Improved training of professionals in relevant sectors                                                                                                                                                                                                                                                                                                                                                            |
| Active environments | Integrated urban and transport planning prioritizing compact, mixed land use to create connected neighbourhoods<br>Improved infrastructure for walking and cycling and public transport<br>Action to improve road and personal safety of pedestrians, cyclists and public transport passengers<br>Improved access to public green and recreational spaces and sports facilities<br>Policy, regulatory and design guidelines to create buildings that promote physical activity (e.g., by promoting the use of stairs) |
| Active people       | Strengthen physical education and opportunities for physical activity at school<br>Physical activity counselling in health care settings<br>Physical activity programs in community settings and for specific groups (e.g., the elderly)                                                                                                                                                                                                                                                                              |
| Active systems      | Policy frameworks, leadership and governance for physical activity<br>Data systems, monitoring and surveillance of relevant population-level physical activity indicators<br>Research and evaluation activities<br>Advocacy for physical activity<br>Financing mechanism for sustained implementation of relevant measures                                                                                                                                                                                            |

recommend that individuals experiencing relevant unwanted weight gain seek medical advice. We recommend that all individuals are offered qualified advice on diet and physical activity in primary care regardless of their weight status. Health care professionals prescribing drugs that are associated with relevant weight gain should take potential effects on body weight into account in their consideration of the overall balance of benefits and harms of prescribing the drug in question. When such a drug is prescribed, patients should be informed that they may gain weight and options for weight management and, if applicable, alternatives to the prescribed medication should be discussed with the patient. To prevent obesity on a population level, evidence-informed measures to create healthy food and physical activity environments are recommended.

*Strengths and Limitations*

This guideline has a number of strengths. It is based on a systematic process of searching for and considering evidence and a structured process of using the clinical and public health expertise of a representative group of experts. It was developed by a multi-disciplinary, multi-professional guideline panel with patient representatives. We used GRADE to assess the certainty of evidence and considered recommendations for individual behaviours, clinical care, and public health in an integrated manner. The guideline has, however, also a number of limitations. Our systematic literature search was limited to systematic

reviews. For some recommendations, we found only limited evidence from systematic reviews, and resource constraints prevented us from conducting more comprehensive and systematic searches. We were not able to conduct GRADE assessments for all recommendations. The recommendations were developed primarily for the adult population in Germany, and while most are likely to be relevant internationally, some may not be directly applicable to other populations.

*Comparison with Other Guidelines*

Existing European obesity guidelines are focused mostly on treatment and do not systematically address prevention [10, 11]. For the UK, the National Institute for Health and Care Excellence (NICE) has published in 2015 guidelines on the prevention of obesity and excess weight gain [13, 14]. These are largely in line with the present guideline. One notable exception is that NICE recommends eating breakfast, while our recommendation No. 11 states that dietary patterns with varying distributions of food intake over the course of the day (including patterns without breakfast) may be practiced. The Canadian Adult Obesity Clinical Practice Guidelines include a background chapter on prevention and harm reduction of obesity but no formally graded recommendations on prevention [12, 15]. Recommendations that can be drawn from this chapter are in line with the present guideline [15]. The US Preventive Services Task Force (USPSTF) has published recommendation statements on

behavioural counselling to promote a healthful diet and physical activity, which are in line with our recommendation No. 21 (the USPSTF recommends that adults with known cardiovascular risk factors are offered such counselling, while the decision to offer such counselling should be individualized for adults without known cardiovascular risk factors) [20, 21]. WHO has published a number of guidelines on dietary intake to prevent unhealthy weight gain and other adverse health effects [19, 37, 38, 59], and on policies to promote healthy diets [135, 136]. The recommendations from these guidelines are mostly in line with ours [135, 136]. A difference in detail exists regarding our recommendations on the use of non-sugar sweeteners in beverages. We recommend beverages without added sweeteners of any kind but suggest that for individuals who do not want to eschew sweetened beverages, beverages with non-sugar sweeteners may be preferable to SSB, in particular when the prevention of short- to medium-term weight gain is a priority. In contrast, WHO recommends that non-sugar sweeteners not be used as a means of achieving weight control [19].

#### *Implications for Policy and Practice*

Representative epidemiological surveys suggest that in most countries, dietary and physical activity patterns are not aligned with the recommendations of this and other evidence-based guidelines [139, 140]. Access to qualified advice on diet and physical activity in the health-care sector is patchy, as is the implementation of evidence-informed policies for creating healthy food and physical activity environments [4, 141]. This suggests that increased efforts are needed to enable individuals to engage in behaviours that prevent obesity. Evidence-based approaches for achieving this objective exist but need to be implemented more widely [8].

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#### **Statement of Ethics**

The study was registered with the German Association of Scientific Medical Societies (Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften e.V., AWMF) at

[www.awmf.org/leitlinien/detail/anmeldung/1/ll/050-001.html](http://www.awmf.org/leitlinien/detail/anmeldung/1/ll/050-001.html). No human subjects were involved in this research and no ethical clearance was sought in line with regulations of the AWMF.

#### **Conflict of Interest Statement**

P.P. reports receiving research funding from Germany's Federal Ministries of Food and Agriculture (BMEL) and Education and Research (BMBF), as well as travel costs and speaker and manuscript fees from the German and Austrian Nutrition Societies (DGE and ÖGE), the German Diabetes Society (DDG), and the German Obesity Society (DAG). H.H. received research funding from the Federal Ministry of Education and Research (BMBF), the Else Kroener-Fresenius-Foundation, Bad Homburg, the German Center for Diabetes Research, and Munich-Neuherberg (GER), is a member of the Oviva Advisory Board, and received funding for the evaluation of an app-based digital weight loss program by Oviva, Berlin. C.J. received lecture fees from Berlin Chemie, MSD Sharpe and Dohme, Novartis, AbbVie, Pfizer, Janssen, Lilly, Chiesi, Chugai, Novo Nordisk, Daiichi-Sankyo, Sanofi, and pharma-cosmos. D.R. reports receiving travel costs from the German Society of Nutritional Medicine (DGEM) and German Society of Internal Medicine (DGIM). C.B. is an employee of the German Nutrition Society, which receives partial funding from Germany's Federal Ministry of Food and Agriculture. C.H. received research funding from Germany's Federal Ministry of Education and Research (BMBF), is a member of the scientific advisory board of 4sigma GmbH, Oberhaching, and received funding for the evaluation of an app-based digital weight loss program by Oviva AG, Berlin, and lecture fees from Novo Nordisk. The other authors state that they have no conflicts of interest to declare. Conflict of interest statements of the members of the guideline committee who are not co-authors of this manuscript are available on the Website of the German Association of Scientific Medical Societies at <https://register.awmf.org/de/leitlinien/detail/050-001>.

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#### **Author Contributions**

Conceptualization, investigation, and writing (review and editing): P.P., M.B., C.B., C.H., C.J., S.P.-D., M.N., D.R., M.R.-F., M.Z., and H.H.; methodology: P.P., M.N., M.Z. and H.H.; data curation and writing (original draft): P.P.; and funding acquisition: H.H. and M.Z.

#### **Data Availability Statement**

The data that support the findings of this study are contained in the manuscript and the online supplementary material or are publicly available as part of the referenced source material.

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