Dutch dietary guidelines for people with type 2 diabetes

To: the State Secretary of Health, Welfare and Sport
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Health Council of the Netherlands

contents

summary

In the *Dutch dietary guidelines 2015*, the Health Council specifies the recommended intake of foods and beverages to prevent chronic diseases. These guidelines are meant for the general population. This includes people with type 2 diabetes, a condition that affects around one million people in the Netherlands. At the time, it was not separately assessed whether the *Dutch dietary guidelines* are entirely appropriate for people with type 2 diabetes. For this group, disease-specific adjustments or additions to the *Dutch dietary guidelines* may be required.

At the request of the State Secretary of Health, Welfare and Sport, the Health Council is now advising on this matter. The Permanent Committee on Nutrition prepared the advisory report.

Striving for weight reduction

A large number of people with type 2 diabetes are overweight or obese, and weight reduction can have significant health benefits for these people. People's energy balance is inextricably linked to dietary intake, which is why the Committee has also addressed weight reduction for people with type 2 diabetes in this advisory report. In case of overweight or obesity, the Committee recommends to strive for a weight reduction of at least 5%, and to maintain this in the long term. For people that aim to lose weight, an energy-restricted diet can be compiled based on the *Dutch dietary guidelines*. However, weight reduction is complex and usually requires addressing multiple factors, including lifestyle-related factors, at the same time. The Committee stresses that a multi-factorial approach is important, but does not discuss the broad range of options that can contribute to weight reduction and maintenance in this advisory report.

No deviations from the *Dutch dietary guidelines* needed

Foods and beverages

The *Dutch dietary guidelines 2015* contain several guidelines for the intake of foods and beverages. Of these, the Committee evaluated the guidelines relating to vegetables, fruit, whole grain foods, legumes, sugar-containing beverages, dairy products, coffee and salt for people with type 2 diabetes. This selection was based on existing dietary guidelines for people with type 2 diabetes and on the expert judgement of the Committee.

The Committee evaluated the effects of these foods and beverages on the same outcome measures as used in the *Dutch dietary guidelines*: mortality and morbidity caused by

the top ten chronic diseases in the Netherlands, body weight, LDL cholesterol and blood pressure. For this advisory report it also examined, among other things, the effects on glucose metabolism. The Committee found a limited number of studies in people with type 2 diabetes that addressed these outcome measures, and although too little research had been done to arrive at a conclusion in some cases, the outcomes were, generally speaking, in accordance with the *Dutch dietary guidelines*. The Committee therefore sees no reason to deviate from the *Dutch dietary guidelines 2015* for people with type 2 diabetes.

Dietary patterns

The *Dutch dietary guidelines* make the overarching recommendation to eat more plant-based foods and fewer animal-based foods, based on evaluations of studies on different dietary patterns, such as Mediterranean, DASH (Dietary Approaches to Stop Hypertension) and vegetarian dietary patterns. Based on existing dietary guidelines for people with type 2 diabetes, the Committee concludes that this overarching recommendation also applies to people with type 2 diabetes.

A carbohydrate-restricted dietary pattern was not evaluated for the *Dutch dietary guidelines*, but is covered in existing dietary guidelines for people with type 2 diabetes. The Committee has therefore considered whether to include carbohydrate restriction in the *Dutch dietary guidelines for people with type 2 diabetes*.

The studies evaluated by the Committee included either severe or moderate carbohydrate restrictions, replacing carbohydrates with fats, proteins or both. Both the carbohydrate-restricted diets and the diets with which they were compared were, in general, calorie-restricted diets. The Committee can therefore only make statements about the effects of prescribing a carbohydrate restriction in conjunction with energy restriction. The participants in the studies had type 2 diabetes and were overweight or obese. The studies show that for these people, severe carbohydrate restriction can contribute to weight reduction in the short term (3 to 6 months) and, possibly as a result, improve glucose metabolism compared to a different dietary pattern. However, the studies show there is no difference any more when comparing severe or moderate carbohydrate restriction for 12 months to other dietary patterns. Therefore, for the promotion of long-term health, the Committee sees no reason to recommend severe or moderate carbohydrate restriction for people with type 2 diabetes. There are hardly any studies on the health effects of long-term severe or moderate carbohydrate restriction. People with type 2 diabetes who wish to reduce their energy intake are advised to do so under the guidance of a dietician. A dietician can ensure that the *Dutch dietary guidelines* are taken into account in the compilation of the diet, and that the diet provides sufficient quantities of important nutrients, including for people who prefer to reduce their energy intake by restricting their carbohydrate intake.

Integrated approach

The Committee's recommendations can be used in public information on nutrition and nutritional care for people with type 2 diabetes, for example by the Netherlands Nutrition Centre and dieticians. The Committee stresses that other lifestyle-related factors, such as physical activity, are also important for people with type 2 diabetes. In treating type 2 diabetes, the *Dutch dietary guidelines* should therefore be part of a broader set of interventions that also focus on other lifestyle-related factors.

01 introduction

This advisory report was prepared by the Permanent Committee on Nutrition of the Health Council of the Netherlands. In it, the Committee answers the question asked by the State Secretary of Health, Welfare and Sport as to whether the *Dutch dietary guidelines* published by the Health Council in 2015 also apply to people with cardiometabolic disorders and whether any disease-specific adjustments or additions are required for them. This request for advice is answered in parts. In this first advisory report, the Committee focuses specifically on people with type 2 diabetes.

1.1 Reason for advisory report

For the general Dutch population (from 2 years of age), the Health Council's *Dutch dietary guidelines 2015* specify the recommended intake of foods and beverages to prevent chronic diseases, including cardiovascular disease, type 2 diabetes and some forms of cancer.[1]

A significant part of the Dutch population already has chronic diseases, such as the cardiometabolic diseases type 2 diabetes and cardiovascular diseases. The Nutrition Committee assumes that the *Dutch dietary guidelines 2015* are also suitable for people with cardiometabolic disorders, as these guidelines are largely based on studies in the general population and not only in healthy populations. People with cardio-metabolic disorders are therefore also covered in the evaluations that form the basis of the *Dutch dietary guidelines*. Several Dutch treatment guidelines for people with type 2 diabetes or cardiovascular disease therefore recommend following the *Dutch dietary guidelines*.[2-4]

At the time, it was not separately assessed whether the *Dutch dietary guidelines* are entirely appropriate for people with type 2 diabetes. More and more studies in people who already have type 2 diabetes or cardio-vascular disease are now being published and there are suggestions that health gains can be achieved for these groups through the diet.[5-7] These studies allow improved insight into whether the *Dutch dietary guidelines* apply to those groups and whether any disease-specific adjustments or additions are required. The State Secretary of Health, Welfare and Sport has now requested the Health Council to issue an advisory report on this matter. The request for advice can be found on the Council's website. This first advisory report focuses specifically on people who already have type 2 diabetes.

This report was prepared by the Permanent Committee on Nutrition, with experts from nutritional, behavioural, medical and paramedical disciplines. A list of the Committee's members can be found at the end of this advisory report. The Health Council Presidency gave stakeholders the opportunity to comment on drafts of the background documents and the advisory report. All comments received and the Committee's responses to them have been published on the Committee's website. The Health Council's Standing Committee reviewed the advisory report, after which the

Council's Presidency presented it to the State Secretary of Health, Welfare and Sport.

1.2 Type 2 diabetes

In 2019, over 1.1 million people with diabetes were known to their GP in the Netherlands. Diabetes is an umbrella term for various metabolic disorders that lead to permanently elevated levels of blood glucose. The best known and most common forms of these disorders are type 2 diabetes and type 1 diabetes. About 90% of people with diabetes have type 2 diabetes. Type 2 diabetes is caused by a combination of genetic predisposition and an unhealthy lifestyle (such as inactivity and an unhealthy diet), with lifestyle-related factors playing the biggest role. Type 2 diabetes occurs more frequently with age, but is also increasingly common in adolescents and young adults.[8,9]

In people with type 2 diabetes, the cells in liver, muscle and fat tissue are less sensitive to insulin (insulin resistance). Moreover, the beta cells of the pancreas usually produce low quantities of insulin (beta cell dysfunction). Insulin is a hormone that is responsible for transporting glucose (from food and other sources) to the cells, where it is either used as fuel or stored. Insulin resistance and beta-cell dysfunction cause glucose levels in the blood to rise (hyperglycaemia). People with type 2 diabetes can develop long-term complications such as cardiovascular disease, chronic kidney damage, foot problems and poor vision, which can have a significant negative impact on their quality of life and longevity.[3,10]

1.3 Users of this advisory report

This advisory report is intended as a basis for the public information on nutrition provided by the Netherlands Nutrition Centre and patient organisations for people with type 2 diabetes. Dieticians can, in cooperation with other healthcare professionals such as general practitioners, diabetes nurses and internists, provide tailored dietary advice to people with type 2 diabetes. These healthcare professionals can use this advisory report as a reference work. Finally, the Council's recommendations can be integrated into broader interventions aimed at promoting a healthy lifestyle for people with type 2 diabetes, which are discussed in greater detail in Chapter 5.

Different dietary recommendations for people with type 2 diabetes

The Health Council has written this advisory report for professionals looking to give nutritional information and/or nutritional care to people with type 2 diabetes.
The primary goal of this advisory report is to promote long-term health and not to reduce acute signs and symptoms of type 2 diabetes. For this advisory report, the Council used the existing *Dutch dietary guidelines* as a starting point and considered whether there were indications that deviating guidelines might better serve people with type 2 diabetes. The *Dutch dietary guidelines* are intended as a basis for a healthy and varied dietary pattern and are based on studies on the health effects of different diets, foods and nutrients. The outcomes of these studies were translated into guidelines for foods and beverages (e.g. vegetables, fruit, sugar-containing beverages). The findings on nutrients have been used as supporting evidence in making these guidelines on foods and beverages. The *Dutch dietary guidelines* therefore do not contain separate guidelines on nutrient intake, nor do they provide guidelines on specific diets (such as Mediterranean or DASH). Rather, they make the overarching recommendation, based on research into healthy diets, to eat more plant-based foods and fewer animal-based foods. The principles of these healthy eating patterns are also reflected in the food and beverage guidelines.

Several other Dutch and international organisations have also drawn up dietary recommendations for people with type 2 diabetes[4,11-16], such as the Netherlands Diabetes Federation (NDF).[4] The NDF guideline is intended as a practical support guideline for healthcare professionals who wish to provide personalised nutritional care. The guideline presents ways to prevent diabetes and how to treat people who already have type 1, type 2 or gestational diabetes. The recommendations are aimed at limiting acute symptoms and promoting long-term health. The NDF guideline provides advice on conventional diets, with separate recommendations on nutrients, foods and dietary patterns, as well as on supplements, weight loss methods, lifestyle programmes and exceptional situations. The NDF guideline also provides practical advice and addresses various points of interest.

Although the Council's and the NDF's recommendations are based on different starting points, and different routes were followed in formulating the guidelines, the dietary recommendations relating to the conventional dietary intake in people already suffering from type 2 diabetes are similar.

1.4 Scope

Although the studies underlying the *Dutch dietary guidelines* mainly enlisted adults, the *Dutch dietary guidelines* are intended for the general population from the age of two years. The studies evaluated for this report were conducted in adults, although type 2 diabetes is becoming increasingly common in children and young adults. From reports on dietary guidelines for people with type 2 diabetes, the Committee found that little or no research has been done on children and young adults [4,11-16] However, as with the *Dutch dietary guidelines*, the Committee sees no reason to believe that its dietary recommendations for people with type 2 diabetes would not be a good basis for children and young adults with type 2 diabetes.

The recommendations in the advisory report do not apply to people with type 2 diabetes who already require dietary advice for other conditions, such as celiac disease (gluten intolerance).

In its evaluation, the Committee mainly found studies that excluded people with serious complications caused by type 2 diabetes, including clinically established macro- and micro-vascular disorders, such as myocardial infarction or severe retinal damage. The Committee's basic assumption is that the *Dutch dietary guidelines* can also promote health in people with illnesses as long as there is no scientific evidence that suggests otherwise. No specific scientific evaluation exists for these groups, and according to the Committee's assumption, the *Dutch dietary guidelines* can therefore serve as a basis for these groups.

The Committee's recommendations are aimed at promoting long-term health (prevention of the most common chronic diseases, as explained in Section 1.5 Methodology), which was also the objective of the *Dutch dietary guidelines*. For people with type 2 diabetes, management of daily blood glucose levels is of importance as well. The consumption of foods rich in complex carbohydrates and dietary fibre, which are recommended in the *Dutch dietary guidelines 2015*, contribute to that.[17,18] However, the Committee did not evaluate the effects of dietary factors on acute, post-prandial effects because the (individual) short-term management of blood glucose levels is not in the scope of the *Dutch dietary guidelines*, which focus on long-term prevention of chronic diseases. In addition to dietary intake, other factors, such as taking glucose-lowering medication and physical exercise, also influence blood glucose regulation in individuals throughout the day. Dieticians, together with other health professionals, can take these factors into account and offer tailored dietary advice.

A healthy diet is part of a healthy lifestyle, but other lifestyle factors such as getting ample exercise and refraining from smoking are important for people's general health, including those with type 2 diabetes. This advisory report is limited to dietary recommendations and does not address other lifestyle factors.

1.5 Methodology

1.5.1 Working group

The Committee set up a working group that prepared the background documents and drew sub-conclusions for each dietary factor and health outcome, before deriving dietary recommendations from this set of sub-conclusions. A list of the members of the Diabetes Working Group can be found at the back of this advisory report. A structured approach was followed in preparing this advisory report, as is described in detail in the background document *Methodology for the evaluation of evidence*.[19]

1.5.2 Dutch dietary guidelines as a starting point

The Committee used the *Dutch dietary guidelines 2015* as a starting point and considered whether there were any indications that adjustments or additions might be needed for people with type 2 diabetes. This means that the Committee recommends that people with type 2 diabetes follow the *Dutch dietary guidelines 2015*, unless proven otherwise. Various treatment guidelines for people with type 2 diabetes, such as the NHG standard, already recommend following the *Dutch dietary guidelines* 2015.[2-4] The Committee also assumes that the *Dutch dietary guidelines 2015* are appropriate for people with type 2 diabetes because they are based on research in the general population and not just in the healthy population. Since part of the general population has type 2 diabetes, this group was implicitly included in the evaluations on which the *Dutch dietary guidelines* are based. The *Dutch dietary guidelines* focus on the prevention of common chronic diseases such as coronary heart disease and stroke, which people with type 2 diabetes have an increased risk of developing. However, studies carried out entirely on people already suffering from type 2 diabetes were not considered in preparing the *Dutch dietary guidelines*. An evaluation of such research could help formulate possible disease-specific adaptations or additions to the *Dutch dietary guidelines* for people with type 2 diabetes.

1.5.3 Selection of dietary factors

In this advisory report, the Committee uses the term ‘dietary factors’ as an umbrella term for foods, beverages, nutrients and dietary patterns.

For eight of the current dietary recommendations in the *Dutch dietary guidelines*, the Committee saw reasons to conduct a specific evaluation for people with type 2 diabetes, namely the guidelines on fruit and vegetables, whole grain foods, legumes, sugar-containing beverages, dairy products, coffee and salt. In addition, the Committee opted to evaluate carbohydrate-restricted dietary patterns.

In selecting these topics, the Committee used Dutch and international reports with dietary guidelines for people with type 2 diabetes.[4,11-16] The dietary factors covered in these reports were compared with the dietary factors evaluated for the *Dutch dietary guidelines 2015*. All dietary factors for which the *Dutch dietary guidelines* contain recommendations were also

covered in the aforementioned reports. All conclusions or recommendations for a dietary factor that differed from the *Dutch dietary guidelines* or that had not been evaluated for the *Dutch dietary guidelines* were considered eligible for evaluation by the Committee. The following considerations were also taken into account in selecting the dietary factors to be evaluated:

1. Coverage of the dietary factor in one or more of the aforementioned reports;
2. Limited scientific evidence on this dietary factor in people with type 2 diabetes in the aforementioned reports;
3. The expert opinion of the Committee (for example: a dietary factor is under discussion among caregivers, policy officers, researchers and/or patients).

A more detailed explanation of the selection of these individual dietary factors is given in the boxes on page 13 and 14.

Only dietary factors that fit into a conventional dietary pattern were selected, and dietary supplements or specific weight-loss diets (such as intermittent fasting or diets with strict energy restriction and meal replacements) were not considered.

For those dietary factors from the *Dutch dietary guidelines* that were not evaluated by the Committee for the current advisory report, the Committee assumes that they are important for people with type 2 diabetes but that no adjustments are necessary for this group, based on the aforementioned reports.[4,11-16]

As many people with type 2 diabetes are overweight or obese and dietary intake is inextricably linked to energy balance, the Committee also addresses the importance of weight reduction. However, the Committee does not make any recommendations on how people with type 2 diabetes can best lose weight and therefore does not specifically address weight-loss diets.

Some of the intervention studies on dietary factors from the *Dutch dietary guidelines* that have been evaluated in people with type 2 diabetes were carried out in combination with mild energy restriction. However, weight reduction was not a primary goal of these studies. In interpreting these studies, the Committee considered whether the prescribed amounts of energy materially differed between the intervention group and the control group.

When reviewing intervention studies on a carbohydrate-restricted dietary pattern, it appeared that most of these studies were carried out with the underlying aim of losing weight, but the Committee did not necessarily select this diet as a weight-loss diet. Moreover, this dietary pattern is not only used for weight reduction, as it can also improve blood glucose

levels, which is why the Committee still included this dietary pattern in its advisory report.

For people with type 2 diabetes looking to watch their weight (maintain their body weight or limit weight gain), the Committee has included in Chapter 5 several pointers with regard to choices that can be made within the food groups on which the Committee advises, such as product type and quantity.

Selection of evaluated dietary factors

Dairy products Cohort studies show that higher consumption of certain subgroups of dairy products, such as yoghurt, is associated with a lower risk of developing type 2 diabetes.[1] This raised the question among the Committee members as to whether dairy products are also beneficial for people who already have type 2 diabetes. The Committee wished to evaluate whether the dairy recommendation could be made more specific with regard to the fat content of the dairy for people with type 2 diabetes. This issue is addressed by only one of the reports with dietary guidelines for people with type 2 diabetes[4] and, according to the Committee, it is currently the subject of debate.

Coffee There is strong evidence from cohort studies that higher coffee consumption is associated with a lower risk of developing type 2 diabetes.[1] This raised the question among the Committee members of whether coffee consumption also benefits the long-term health of people who already have type 2 diabetes. The association between coffee consumption and the long-term health of people already suffering from type 2 diabetes was addressed in only one of the reports with dietary guidelines for people with type 2 diabetes, dating from 2010.[16] In order to gain a good understanding of the current state of scientific knowledge by examining more recent literature, the Committee decided to include this topic in its evaluation.

(continued on next page)

Selection of evaluated dietary factors (continued)

Salt The *Dutch dietary guidelines* recommend eating no more than 6 grams of salt per day, which is equivalent to 2400 mg of sodium per day. According to the Committee, it has been debated whether the maximum sodium intake should be lower for people with type 2 diabetes, given their higher risk of developing chronick-idney disease and cardiovascular disease.[20] The Committee wished to evaluate whether the recommended maximum salt intake should be adjusted for people with type 2 diabetes. Salt is a topic that was also addressed in the reports with dietary guidelines for people with type 2 diabetes.[4,11-14,16]

Carbohydrate-restricted dietary patterns and carbohydrate sources Several dietary patterns, such as Mediterranean, DASH and vegetarian dietary patterns, were evaluated for the *Dutch dietary guidelines*. These dietary patterns were found to be beneficial for overall health. Since the diets in question shared many similarities, such as a relatively high intake of plant-based products and fish and a relatively low intake of red and processed meats and hard fats, the findings on these dietary patterns were ultimately reflected in the overarching recommendation to: 'Follow a dietary pattern that involves eating more plant-based and less animal-based food'. The underlying principles of these dietary patterns are also reflected in the guidelines on the level of foods and beverages. The Committee found no discrepancies in conclusions about the dietary patterns in question, such as the Mediterranean diet, in reports with guidelines for people with type 2 diabetes. However, it did note that these reports do cover carbohydrate-restricted dietary patterns, which had not been evaluated for the *Dutch dietary guidelines*.[4,11-16]

These dietary patterns are of particular interest to people with type 2 diabetes, due in part to the fact that carbohydrates directly affect blood glucose levels.[21-27] The Committee has therefore considered whether the *Dutch dietary guidelines for people with type 2 diabetes* should set a limit for the maximum recommended percentage of energy derived from carbohydrates.

As the *Dutch dietary guidelines* make recommendations about foods and given the fact that the quantity of carbohydrates and the quality of carbohydrate food sources (such as fruit and cereal products) can both matter for health[28], the Committee evaluated the carbohydrate food sources about which the *Dutch dietary guidelines* made recommendations for people with type 2 diabetes. This includes vegetables, fruit, whole grain products, legumes and sugar-containing beverages. The Committee also evaluated the literature on dietary fibre from vegetables, fruit, whole grain and oat products for people with type 2 diabetes. These dietary factors were also addressed in reports presenting dietary guidelines for people with type 2 diabetes.[4,11-14,16]

1.5.4 Selection of health outcomes

The purpose of this advisory report is to promote the long-term health of people with type 2 diabetes. In its evaluation, the Committee used the same health outcomes used for the *Dutch dietary guidelines*. To this end, it looked at the top ten chronic diseases in the Netherlands measured in terms of mortality, years of life lost and burden of disease. In addition, the Committee searched for studies with all-cause mortality and chronic kidney disease as health outcomes.

As with the *Dutch dietary guidelines*, the Committee also considered so-called surrogate outcomes, which can be seen as substitute outcomes for chronic disease and reflect the causal pathway leading from a dietary factor to chronic disease.[29] LDL cholesterol, for example, is a surrogate outcome for coronary heart disease. An advantage of such surrogate outcomes is that they make it possible to observe the effects of nutrition relatively soon. For example, effects on LDL cholesterol can be visible in a few weeks, whereas it takes years to observe effects on coronary heart disease. Surrogate outcomes included in this advisory report are body weight, systolic blood pressure and LDL cholesterol. The Committee also looked at HbA1c (a measure that gives an impression of the average blood glucose level over a number of months), fasting blood glucose level, and kidney function (estimated glomerular filtration rate, eGFR).

In scientific research, more and more attention is being paid to the possibility of reversing type 2 diabetes with lifestyle interventions (diabetes remission*;* in which the use of diabetes medication is stopped for more than a year and HbA1c is lower than 48 mmol/mol) or reducing its severity (diabetes reversal*;* in which the use of diabetes medication is reduced for more than a year and HbA1c is lower than 54 mmol/mol). However, insufficient literature was available on these health outcomes that met the Committee's inclusion criteria, e.g. because diet was examined as part of a larger package of lifestyle interventions or because intervention studies were not randomised. Therefore, the Commission does not address the relationship of the selected nutritional factors to diabetes remission or reversal in this advisory report, and none of its recommendations relate to said phenomena.

1.5.5 Literature review and data integration

To evaluate the health effects of the selected dietary factors in people with type 2 diabetes, the Committee conducted a literature review, relying primarily on meta-analyses, pooled analyses and systematic reviews. Two types of studies were described and assessed: randomised controlled trials (RCTs) and prospective cohort studies. A prospective cohort study examines the relationship between diet and chronic disease by monitoring a group of individuals for an extended period of time. In RCTs, participants are divided into groups by drawing lots, with one group receiving the treatment of which the researchers want to measure the effects, and the

other group serving as a control. Both study types have their own advantages and disadvantages and complement each other. When RCTs are available, the Committee speaks of effects; for findings based on cohort studies, the Committee uses the term associations. In addition to meta-analyses, pooled analyses and systematic reviews, the Committee searched for individual RCTs and cohort studies.

In each case, the Committee indicates whether the strength of evidence for an effect or association is strong or limited. Strength of evidence is determined on the basis of the size (number of sub-studies and participants), quality and uniformity of the studies, before weighing all evidence for each food group in its entirety. The Committee considers an effect convincing if strong evidence from cohort studies and RCTs support each other or if there is strong evidence from RCTs. If there is only strong evidence based on cohort studies, the Committee considers the effect plausible. All degrees of evidence (including limited evidence) can support an existing recommendation in the *Dutch dietary guidelines 2015*. The difference between 'convincing' and 'plausible' is usually reflected in the wording of the associated guideline. If there is 'convincing' evidence, the associated guideline will usually contain a quantitative recommendation (eat or take a certain amount); while no quantitative recommendation will usually be given if the evidence is only 'plausible'. Only convincing evidence can give rise to modifying an existing recommendation in the *Dutch dietary guidelines 2015* for people with type 2 diabetes.

To evaluate the health effects of carbohydrate-restricted dietary patterns, the Committee used a report from the *Scientific Advisory Committee on Nutrition* (SACN; UK) published in 2021 as its point of departure.[15] This report contains a review of the scientific evidence on the effects of carbohydrate-restricted dietary patterns in people with type 2 diabetes. The literature selected by SACN was supplemented by more recent literature.

1.6 Reading guide

In Chapter 2, the Committee briefly discusses the importance of weight reduction for people with type 2 diabetes who are overweight or obese. In Chapter 3, it discusses findings on the evaluated foods and beverages from the *Dutch dietary guidelines*, indicating whether these findings give rise to any changes to the recommendations for people with type 2 diabetes. In Chapter 4, the Committee examines the effects of carbohydrate-restricted dietary patterns on the health of people with type 2 diabetes. Finally, Chapter 5 lists the recommendations and provides some additional advice.

02
weight reduction and maintenance

The Committee recommends that people with type 2 diabetes who are overweight or obese should aim for weight reduction and maintain their reduced weight in the long term. For people that aim to lose weight, an energy-restricted diet can be compiled based on the *Dutch dietary guidelines*. However, weight reduction is complex and usually requires addressing multiple factors, including lifestyle-related factors, at the same time. The Committee stresses that a multi-factorial approach is important, but does not discuss the broad range of options that can contribute to weight reduction and maintenance in this advisory report.

2.1 Recommendation

In the case of overweight and/or obesity, aim for at least 5% weight reduction and maintain this in the long term.

2.2 Explanation

A large number of people with type 2 diabetes are overweight or obese, and weight reduction can have significant health benefits for these people. Because dietary intake is inextricably linked to energy balance, the Committee issues additional recommendations on weight reduction for people with type 2 diabetes, supplementing the recommendations given on the *Dutch dietary guidelines*.

Definition of overweight and obesity

By overweight, the Committee means a Body Mass Index (BMI) between 25 and 30 kg/m^2 for adults up to the age of 70 and a BMI between 28 and 30 kg/m^2 for people over 70. Older adults have the lowest risk of mortality with a higher BMI than younger adults, which is why the lower limit for overweight in the elderly is higher. The Committee defines obesity as a BMI of 30 kg/m^2 or higher for all adults. There are age-dependent cut-off points for children.[30,31]

The Committee also wishes to note that the health risks of being overweight or obese are not determined by BMI alone. The health risks of being overweight or obese for instance increase when people also have accumulations of abdominal fat.[32]

2.2.1 Findings on weight reduction and maintenance

A meta-analysis (2015) of regular lifestyle intervention studies shows that 5% weight reduction is feasible and can help to improve the health of people with type 2 diabetes. The meta-analysis shows that weight reduction of 5% or more in people with type 2 diabetes who are overweight or obese can lead to significant improvements in their HbA1c, blood lipid values and blood pressure.[33] A more recent intervention study shows that more than 5% weight reduction is possible in some people with type 2 diabetes and that this can be maintained over a period of several years. The success factors underlying said weight reduction and maintenance are not yet clear, but it is likely that the intensive supervision in the intervention study played an important role in the success, as did the participants' profiles. The participants had, for instance, been

diagnosed with diabetes relatively recently and did not use insulin therapy. Furthermore, an additional analysis showed that 64% of people with type 2 diabetes had diabetes remission when they maintained a weight reduction of 10 kg or more for two years.[34]

Other methods can also help achieve weight reduction, but exhaustively listing these methods is beyond the scope of this advisory report.

2.2.2 The *Dutch dietary guidelines* and weight reduction

The *Dutch dietary guidelines* advise on dietary quality and are not designed with the primary goal of weight reduction. Nevertheless, people can also restrict their energy intake with a dietary pattern based on the *Dutch dietary guidelines*. Section 5.2.2 explains how to take energy (and nutrient) requirements into account in translating the Committee's advice into a recommendation for an individual with type 2 diabetes. Energy-restricted eating based on the *Dutch dietary guidelines* should be seen in a wider context of weight-reduction interventions, as weight reduction can be achieved in several ways, is a complex process and often requires a multifactorial approach.[31,35-37]

2.2.3 Weight reduction in children and the elderly

In children, weight reduction should take growth into account. In the elderly, the consensus is that weight reduction should only be considered in cases of obesity, partly because there is also loss of bone and muscle mass during weight loss.[38]

03
dutch dietary guidelines

The *Dutch dietary guidelines* describe the recommended intake of foods and beverages for the prevention of chronic diseases. A limited number of studies have been found that address the dietary factors from the *Dutch dietary guidelines 2015* in relation to the health of people with type 2 diabetes. Based on the studies found, the Committee sees no reason to recommend deviations from the *Dutch dietary guidelines 2015* for this population.

3.1 Recommendation

The *Dutch dietary guidelines* are a suitable basis for a healthy and varied dietary pattern for people with type 2 diabetes.

3.2 Explanation

The Committee evaluated the 2015 dietary guidelines for fruit, vegetables, whole grain foods, legumes, sugar-containing beverages, dairy products, coffee and salt for people with type 2 diabetes. For the remaining 2015 guidelines, the Committee assumes, based on its expertise and evidence-based dietary guidelines published by other organisations, that no adjustments are needed for people with type 2 diabetes.[4,11-16] In this chapter, the Committee describes its findings for each of the dietary guidelines it evaluated.

3.2.1 Findings on fruit and vegetables

Evaluated dietary factors

The Committee focused on studies that examined the intake of fruit and/or vegetables. The definition of fruit and vegetables is based on nutritional value, taste and culinary application.[39] Fresh fruit, dried fruit and canned fruit were all considered fruit. The definition does not cover fruit or vegetable juices, because they have different nutritional values and food matrices. The evaluated studies dealt mainly with fresh fruit.[40]

The Committee intended to include studies on dietary fibre from fruit and vegetables to supplement the evidence from studies on fruit and vegetables, but could not find sufficient relevant research. The Committee mainly found RCTs on supplementation with isolated dietary fibre. Those studies were not included because the effects of isolated and processed fibres on health outcomes may differ substantially from the effects of fibre from the regular diet.[41] The Committee also found studies on fibre from a combination of different foods. Those studies were not included because the results of such studies cannot provide sufficient information about the health effects of specific fruit and/or vegetables.[42]

Table 1 describes the Committee's conclusions. Based on cohort studies, the Committee found it plausible that each 100 gram higher intake of fruit reduced the risk of cardiovascular disease with 15% in people with type 2 diabetes. This conclusion was based on studies in which the participants ate no more than 400 grams of fruit a day and supports the recommendation on fruit in the *Dutch dietary guidelines*. The cohort

studies did not show any unfavourable associations between fruit consumption and the health of people with type 2 diabetes. Based on these findings, the Committee concludes that there is no reason to deviate from the existing guideline for fruit for people with type 2 diabetes. The Committee cannot make any statements about adjusting any quantities specified in the guideline, because the evidence found is plausible (and not convincing; as no RCTs were found).

The Committee also found, based on cohort studies, that a higher intake of vegetables is associated with a lower risk of all-cause mortality. This finding supports the recommendation on vegetables in the *Dutch dietary guidelines*.

Table 1 Overview of conclusions on the associations of fruit and vegetable consumption with health outcomes based on cohort studies in people with type 2 diabetes[a].

Health outcome[b]	Fruit	Vegetables	Combination of fruit and vegetables
All-cause mortality	Inconclusive evidence	A higher intake is associated with a lower risk; limited evidence	No (relevant) studies found
Morbidity or mortality due to cardiovascular disease	The risk decreases by 15% with every 100 g/d higher intake; strong evidence	Too little research	Too little research
Morbidity due to coronary heart disease	Too little research	No (relevant) studies found	No (relevant) studies found
Morbidity due to stroke	Too little research	No (relevant) studies found	No (relevant) studies found
Mortality due to cancer	Too little research	Too little research	No (relevant) studies found

[a] More information on how the Committee reached these conclusions can be found in the background document *Fruit and vegetables*.[40]

[b] The table lists the outcome measures for which (relevant) studies were found. For the outcome measures not shown in the table, no (relevant) studies were found.

3.2.2 Findings on whole grain foods

Evaluated dietary factors

The Committee focused on studies on the intake of whole grain foods or oat products. Studies on dietary fibre from whole grain foods and oat products were also considered. Studies on supplementation with isolated dietary fibre and studies on dietary fibre from a combination of different foods were excluded (for the same reasons given in the section on fruit and vegetables).[42,43]

Table 2 describes the Committee's conclusions. There is too little research available on the effects of consuming whole grain foods or oat products on the health of people with type 2 diabetes. However, there are systematic reviews that include some relevant RCTs on the short-term effects of dietary fibre from whole grain foods and oat products on surrogate outcomes in people with type 2 diabetes. The RCTs described in these reviews are generally quite limited in size and there is a lot of variation between the RCTs (e.g. in the duration of the study and the amount of fibre examined). Results might also have been biased due to high dropout rates and poor dietary compliance in some RCTs. These differences and limitations have probably led to the fact that there is no conclusive evidence on the effects of dietary fibre from whole grain foods on fasting blood glucose levels. Both favourable and neutral effects were reported, while no unfavourable effects were found. There are too few RCTs to draw conclusions about the effects on other surrogate outcomes, such as HbA1c.

The Committee concludes that, for people with type 2 diabetes, there is no reason to deviate from the recommendations on whole grain foods in the *Dutch dietary guidelines*, because too few studies were found on this subject. For the effects of dietary fibre from whole grain foods on fasting blood glucose levels, the Committee found both favourable and neutral results, and thus no unfavourable results. Therefore, the Committee sees no reason to adjust the recommendation on whole grain foods for people with type 2 diabetes.

Table 2 Overview of conclusions on the associations of consumption of (dietary fibre from) whole grain foods and oat products with health outcomes in people with type 2 diabetes[a].

Health outcome[b]	Type of study	Results
All-cause mortality	Cohort studies	Too little research
Mortality due to cardiovascular disease	Cohort studies	Too little research
HbA1c	RCTs	Too little research
Fasting blood glucose levels	RCTs	Inconclusive evidence[c]
Body weight	RCTs	Too little research
LDL cholesterol	RCTs	Too little research
Systolic blood pressure	RCTs	Too little research

[a] More information on how the Committee reached these conclusions can be found in the background documents *Whole grain foods* and *Dietary fibre*.[42,43]

[b] The table lists the outcome measures for which (relevant) studies were found. For the outcome measures not shown in the table, no (relevant) studies were found.

[c] Over a period of 1 to 3 months. Too little research was found to allow conclusions to be drawn about effects over a one-year period.

3.2.3 Findings on legumes

Evaluated dietary factors

The Committee focused on studies on the intake of legumes. By legumes, the Committee means beans, soybeans, lentils, chickpeas and split peas. Peanuts, green peas, podded peas, broad beans and French beans do not belong to the legumes in this advisory report, in accordance with the method adopted for the *Dutch dietary guidelines* (where the aforementioned foods are classified as nuts or vegetables).[1]

The Committee evaluated soybeans and other legumes separately because soybeans contain more fat, are processed differently and contain isoflavones. However, too little relevant research on soybeans was found. The Committee mainly found RCTs on the effects of supplementation with isolated substances from soybeans, such as isoflavones and soy protein. Those studies were not included because isolated substances may have different health effects than the whole product.[44]

Table 3 shows the Committee's conclusions. Cohort studies show that a higher consumption of legumes is associated with a lower risk of mortality due to cardiovascular disease and all-cause mortality. The level of evidence is limited due to some heterogeneity in the findings between studies and methodological limitations in one of the evaluated studies. For cancer mortality, both neutral and protective associations were found with higher legume consumption. The favourable associations emerging from cohort studies are corroborated by findings from RCTs. Those RCTs show that consumption of legumes, compared to other foods, can reduce HbA1c, fasting blood glucose levels and body weight in people with type 2 diabetes. Again, the evidence is limited. This is partly because the RCTs are rather small, differ in design (such as study duration, amount and type of legumes and type of control food) and a number of studies had potentially biased results.

The limited evidence available for people with type 2 diabetes supports the recommendation on legumes in the *Dutch dietary guidelines*.

Table 3 Overview of conclusions on the associations between consumption of legumes and health outcomes in people with type 2 diabetes[a].

Health outcome[b]	Type of study	Results
All-cause mortality	Cohort studies	A higher intake is associated with a lower risk; limited evidence
Mortality due to cardiovascular disease	Cohort studies	A higher intake is associated with a lower risk; limited evidence
Mortality due to cancer	Cohort studies	Inconclusive evidence
HbA1c	RCTs	A higher intake has a reducing effect[c]; limited evidence
Fasting blood glucose levels	RCTs	A higher intake has a reducing effect[c]; limited evidence
Body weight	RCTs	A higher intake has a reducing effect[c]; limited evidence
LDL cholesterol	RCTs	Too little research
Systolic blood pressure	RCTs	Too little research

[a] More information on how the Committee reached these conclusions can be found in the background document *Legumes*.[44]

[b] The table lists the outcome measures for which (relevant) studies were found. For the outcome measures not shown in the table, no (relevant) studies were found.

[c] Over a period of 1 to 3 months.

3.2.4 Findings on sugar-containing beverages

Evaluated dietary factors

The Committee intended to base its assertions on studies that compared the consumption of sugar-containing beverages with the consumption of beverages without added sugar (in RCTs) or a lower consumption of sugar-containing beverages (in cohort studies). By sugar-containing beverages, the Committee means cold beverages with added sucrose, fructose or glucose, as well as beverages that naturally contain sugars, such as fruit juices.

The Committee did not find any appropriate RCTs for its evaluation. It mainly found reviews of RCTs on the effects of fructose compared to a similar amount of energy from other carbohydrates, such as glucose or starch. The Committee did not include these studies in its evaluation of sugar-containing beverages because they examine the substitution of different kinds of carbohydrates, rather than beverages with and without sugars. Moreover, in the vast majority of studies, participants were not or not only given carbohydrates in the form of beverages. The Committee did not find sufficient appropriate cohort studies for its evaluation.[40,45]

The Committee did not find sufficient relevant research on sugar-containing beverages in people with type 2 diabetes. It therefore concludes that, for people with type 2 diabetes, there is no basis for deviating from the recommendation in the *Dutch dietary guidelines* to drink as few sugar-containing beverages as possible. More information on the Committee's evaluation of sugar-containing beverages can be found in the background documents *Beverages with added sugar* and *Fruit and vegetables*.[40,45]

3.2.5 Findings on dairy products

Evaluated dietary factors

The Committee searched for studies on the intake of dairy products. By dairy products, the Committee means milk and products made from milk, such as yoghurt and cheese. The Committee also searched for studies that distinguished between sub-groups of dairy: whole, semi-skimmed and skimmed milk products and specific (groupings of) dairy products such as milk, fermented products, yoghurt and cheese. In this advisory report, butter is not classified with dairy products. The Committee did not find sufficient studies that could be used for its evaluation of dairy products in general or for sub-groups of dairy product.

The Committee did find RCTs on probiotic dairy, fortified dairy (such as with vitamin D or calcium) and dairy protein. Almost all studies on probiotic and fortified dairy products compare these products with a non-probiotic or non-fortified dairy product. As such, these studies cannot be used to determine the effect of the dairy product itself, for which reason they were excluded from the Committee's evaluation. Studies on the effects of dairy proteins, such as whey and casein, focused on acute effects (within a few hours) on the regulation of blood glucose levels. These studies were therefore also excluded. The primary focus of the Committee is long-term health and it is unclear to what extent acute effects can be translated into the longer term.[46]

The Committee did not find sufficient relevant research on health effects of dairy products in people with type 2 diabetes. It therefore concludes that, for people with type 2 diabetes, there is no basis for deviating from the recommendation in the *Dutch dietary guidelines* to take several portions of dairy a day. The Committee also sought to specifically identify whether there were any studies on full-fat versus skimmed or semi-skimmed dairy products in people with type 2 diabetes. However, too little research was found to draw any conclusions. The recommendation on dairy products in the *Dutch dietary guidelines* does not distinguish between the fat content of dairy products, because there was insufficient scientific basis for doing so. The Committee sees no basis for deviating from this for people with type 2 diabetes. More information on the Committee's evaluation of dairy products can be found in the background document *Dairy products*.[46]

3.2.6 Findings on coffee

Evaluated dietary factors

The Committee focused on studies on coffee intake. Where possible, the Committee distinguished between filtered and unfiltered coffee and between caffeinated and decaffeinated coffee. Cohort studies on caffeine from coffee were also included, as these also reflect coffee consumption. Cohort studies on caffeine in general were not included, as caffeine is also found in other foods (such as tea and soft drinks) and the results of these studies therefore provide insufficient information about the health effects of coffee.

RCTs were found on the acute effects (within a few hours) of coffee on the regulation of blood glucose levels, but these were not included. The primary focus of the Committee is long-term health and it is unclear to what extent acute effects can be translated into the longer term.[47]

The *Dutch dietary guidelines* recommend replacing unfiltered coffee with filtered coffee, because unfiltered coffee can increase LDL cholesterol. No studies on filtered versus unfiltered coffee in relation to LDL cholesterol (or other health outcomes) in people with type 2 diabetes were found. However, the Committee did specifically look for studies on the association between coffee consumption and chronic diseases, since a protective association with strong evidence was found between coffee consumption and the risk of type 2 diabetes when preparing the *Dutch dietary guidelines 2015*.

Table 4 describes the Committee's conclusions. Based on cohort studies, the Committee found it plausible that drinking coffee is associated with a lower risk of cardiovascular disease. It found that drinking two to four cups of coffee a day is associated with a 20 to 30% lower risk of cardiovascular disease compared to drinking no coffee or sporadically drinking coffee in people with type 2 diabetes (strong evidence). These studies involved caffeinated coffee or a mix of caffeinated and decaffeinated coffee, with no apparent difference in how these associate with the risk of cardiovascular disease. The studies often did not specify how the coffee was prepared but, based on the countries of origin of the studies, the Committee expects that most of the coffee consumed by the participants was filtered.

Based on this, the Committee sees no reason to adjust the recommendation from the *Dutch dietary guidelines* (replace unfiltered coffee with filtered coffee) for people with type 2 diabetes. The Committee cannot add any quantities to the recommendation, as the association found was only 'plausible' (and not 'convincing').

Table 4 Overview of conclusions on the associations between coffee intake and health outcomes based on cohort studies in people with type 2 diabetes[a].

Health outcome[b]	Results
All-cause mortality	A higher intake is associated with a lower risk; limited evidence
Morbidity or mortality due to cardiovascular disease	Drinking two to four cups of coffee a day is associated with a 20 to 30% lower risk compared to not drinking coffee or sporadically drinking coffee; strong evidence.
Morbidity or mortality due to cardiovascular disease	A higher intake is associated with a lower risk; limited evidence
Morbidity or mortality due to stroke	Too little research
Mortality due to cancer	Too little research

[a] More information on how the Committee reached these conclusions can be found in the background document *Coffee*.[47]

[b] The table lists the outcome measures for which (relevant) studies were found. For the outcome measures not shown in the table, no (relevant) studies were found.

3.2.7 Findings on salt

Evaluated dietary factors

The Committee focused on studies on the intake of salt (sodium chloride) or sodium. The Committee also included studies on sodium chloride supplements, as it considers these to be similar to adding table salt (sodium chloride). The Committee examined studies where salt or sodium intake was measured in urine collected (preferably repeatedly) over 24 hours, as this method is more reliable than a questionnaire.[48]

Table 5 describes the Committee's conclusions. RCTs show that a lower intake of sodium can reduce (systolic) blood pressure in people with type 2 diabetes, although the evidence is limited. This is partly because the studies are quite small and there is some heterogeneity in findings between studies. The favourable effect of a lower sodium intake supports the recommendation on salt in the *Dutch dietary guidelines* to limit the intake of salt to no more than 6 grams per day. Based on the RCTs found, the Committee does not rule out the possibility that a further reduction in salt intake has a favourable or more favourable effect on blood pressure in people with type 2 diabetes. However, there is currently too little research to say this with certainty and/or to establish a specific recommended quantity of salt.

Table 5 Overview of conclusions on the associations between sodium intake and health outcomes in people with type 2 diabetes[a].

Health outcome[b]	Type of study	Results
All-cause mortality	Cohort studies	Too little research
Mortality due to cardiovascular disease	Cohort studies	Too little research
Morbidity due to cardiovascular disease	Cohort studies	Too little research
Morbidity due to coronary heart disease, stroke or heart failure	Cohort studies	Too little research
HbA1c	RCTs	Too little research
Systolic blood pressure	RCTs	A lower intake has a reducing effect[c]; limited evidence

[a] More information on how the Committee reached these conclusions can be found in the background document *Sodium*.[48]

[b] The table lists the outcome measures for which (relevant) studies were found. For the outcome measures not shown in the table, no (relevant) studies were found.

[c] Over a period of 5 days to 3 months.

04 carbohydrate-restricted dietary pattern

The Committee sees no reason to recommend carbohydrate restriction to people with type 2 diabetes. However, it also sees no reason to advise against carbohydrate restriction for people with type 2 diabetes who aim to reduce their energy intake, provided that care is taken to ensure that the dietary pattern provides sufficient quantities of important nutrients and that the *Dutch dietary guidelines* are taken into account in the compilation of the dietary pattern. Therefore, guidance from a dietician is recommended.

4.1 Recommendation

A carbohydrate-restricted dietary pattern may help achieve short-term weight reduction and improve glucose metabolism in people with type 2 diabetes who are overweight or obese, but it is not recommended to improve long-term health. This dietary pattern is also not discouraged for people with type 2 diabetes who are overweight or obese and aim to reduce their energy intake. Guidance from a dietician is preferable.

4.2 Explanation

The Committee's recommendation is based on research into health effects over a period no longer than 1 year. The effects of following a carbohydrate-restricted dietary pattern for an extended period of time (more than a year) are not sufficiently known.

The Committee's recommendation is based on research into the effects of prescribing a carbohydrate-restricted dietary pattern in conjunction with energy-restriction, and compared with another dietary pattern that reduces energy intake in a different way. This is because the studies that were deemed suitable for the Committee's evaluation always compared the health effects of a carbohydrate-restricted dietary pattern with the effects of another dietary pattern, both of which were generally energy-restricted diets.

The evaluated studies were conducted in people with type 2 diabetes who were also overweight or obese, which is why the Committee's recommendation applies to this group of people.

4.2.1 Findings on carbohydrate restriction

The box on pages 31 and 32 describes the evaluated carbohydrate-restricted dietary patterns and the dietary patterns with which they were compared. Table 6 describes the Committee's conclusions on the effects of dietary patterns with very low, low and moderate amounts of carbohydrates on health outcomes.

Evaluated dietary factors

Carbohydrates

Carbohydrates can be divided into digestible and indigestible carbohydrates. Digestible carbohydrates are energy-providing nutrients (along with proteins, fats, some dietary fibres and, optionally, alcohol). A distinction can be made between mono- and disaccharides (also called sugars), oligosaccharides, polysaccharides and polyols.

- Monosaccharides: The main monosaccharides are glucose and fructose. These are found in products such as fruit, fruit juice and certain vegetables such as cabbage and pumpkin.
- Disaccharides: The main disaccharides are sucrose and lactose. Sucrose is found in soft drinks, cakes and biscuits, and sugar, jam and chocolate. Lactose occurs naturally only in milk and milk products.
- Oligosaccharides: Malto-oligosaccharides are mainly derived from partially hydrolysed starch. Fully and partially hydrolysed starch and high-fructose corn syrup are increasingly used in certain countries, especially the United States, to replace sucrose in sweets and soft drinks.
- Polysaccharides: The main polysaccharide is starch. Major sources of starch are cereal products such as bread, rice and pasta, tuberous plants (potatoes) and legumes.
- Polyols: These are sugar alcohols used as sweeteners in food. According to European legislation, they fall into the category of carbohydrates, but they are not classified with 'saccharides'.[49]

Indigestible carbohydrates are dietary fibres.

Carbohydrate-restricted dietary patterns

A carbohydrate-restricted dietary pattern is a dietary pattern with relatively few carbohydrates and relatively large quantities of protein and/or fat. The Committee evaluated the health effects of prescribing:

1. A diet or dietary pattern low or very low in carbohydrates:
   a. Very low means: 20 to 50 grams of carbohydrates per day; 10% or less of the overall energy intake comes from carbohydrates. Such a dietary pattern is also known as a ketogenic diet.
   b. Low means between 50 and 130 grams of carbohydrates a day; 10 to 26% of the overall energy intake comes from carbohydrates;

   The Committee also refers to this as a low or very low-carbohydrate '*diet'*, because it differs significantly from the usual dietary pattern of the average adult Dutch person. To illustrate: on average, Dutch adults obtain 43% of their daily energy from carbohydrates[50], while the included studies evaluated a carbohydrate intake that, in many cases, did not exceed 20% of the overall energy intake.
2. A dietary pattern with a moderate amount of carbohydrates: 130 to 230 grams of carbohydrates per day; 26 to 45% of the overall energy intake comes from carbohydrates. The committee refers to this as a *'dietary pattern'* with a moderate amount of carbohydrates, because the percentage of carbohydrates in such a dietary pattern differs little from that of the average Dutch adult (43% of the overall energy intake).[50] The included studies mostly evaluated a carbohydrate intake equal to about 40% of the overall energy intake.

Evaluated dietary factors (continued)

The aforementioned definition is based on the most common classification of carbohydrates, that of Feinman et al.[51] As there were too few studies for a stand-alone evaluation of very low-carbohydrate diets, the Committee combined very low and low-carbohydrate diets in its evaluation. Any reference to carbohydrate-restricted dietary patterns in this advisory report refers to very low, low and moderate-carbohydrate dietary patterns.

In the reviewed studies, the carbohydrate-restricted dietary patterns were mostly examined with the underlying goal of weight loss. The carbohydrate-restricted dietary patterns were not always prescribed with an energy restriction, but usually led to a reduction in energy intake, most likely due to the limited food choices available to participants.

The definition of carbohydrate-restricted dietary patterns does not distinguish between the type of carbohydrates (such as sugars or starches) or which dietary sources of carbohydrates (such as fruit, grain products, sugar-containing beverages) are restricted. As the evaluated studies only report on this distinction to a limited extent, the Committee was also unable to make a distinction between the type and/or source of carbohydrates in its evaluation.[52]

Diets used for comparison

The carbohydrate-restricted dietary patterns were compared with various other dietary patterns, such as low-fat, low-glycaemic-index, energy-restricted dietary patterns and dietary patterns in line with the treatment guidelines for type 2 diabetes. Most of these dietary patterns were energy-restricted. It is likely that the dietary patterns to which the carbohydrate-restricted dietary patterns are compared also impacted health. Due to the wide variety of dietary patterns in the studies, it was not possible to distinguish between them in the evaluation. However, the Committee did consider whether the dietary patterns to which the carbohydrate-restricted dietary patterns were compared were relatively high in protein, fat or both. It was not possible to distinguish between the subtypes of fat (such as saturated, monounsaturated, polyunsaturated) or protein (such as plant-based or animal protein).[52]

Very low or low-carbohydrate diet

The Committee found a convincing effect based on strong evidence from RCTs, namely that, compared to a different energy-restricted dietary pattern, prescribing a low or very-low carbohydrate diet leads to a 0.36% to 0.49% reduction in HbA1c and 2.5 kg in body weight in the short term (3 to 6 months). A short-term reduction in fasting blood glucose levels was also found (limited evidence). In the Committee's view, it is uncertain whether these effects on HbA1c and body weight are clinically meaningful, as they are short-lived.

No studies were found on the occurrence of long-term chronic diseases, such as cardiovascular disease, in relation to a very low or low-carbohydrate diet. However, several RCTS were found that examined the longer-term effects on surrogate health outcomes, which usually covered a 12-month period. These studies showed no difference between prescribing a very low or low-carbohydrate diet and other energy-restricted diets with more carbohydrates in terms of the effect on HbA1c, body weight and other health outcomes.

In the evaluated studies, the Committee noted the participants had difficulties to adhere to a very low or low-carbohydrate diet in the long term, which may explain, at least in part, why the beneficial effects of a very low or low-carbohydrate diet were not seen in the longer term.

Dietary pattern with a moderate amount of carbohydrates

The evaluated RCTs show no relevant difference between prescribing a dietary pattern with a moderate amount of carbohydrates and a dietary pattern with more carbohydrates that restricts energy intake in another way in terms of the effect on the health of people with type 2 diabetes. This applies to both the short and longer term (usually 12 months). However, the Committee did see variation in the effects (favourable, neutral and unfavourable) of a dietary pattern with a moderate amount of carbohydrates on LDL cholesterol. This point merits further attention (see Section 4.2.2*)*.

Energy restriction

In most cases, the evaluated dietary patterns were restricted in energy intake. As explained in Chapter 2, weight reduction can have health benefits for people with type 2 diabetes. Energy restriction, in the broader context of weight reduction interventions, can contribute to this. Based on the evaluated studies, it seems to make little or no difference whether energy restriction is achieved through carbohydrate restriction or another dietary pattern that restricts energy intake in another way. However, the Committee was unable to make a specific comparison with other dietary patterns, because the dietary patterns to which carbohydrate-restricted dietary patterns were compared in the studies were very diverse.

Conclusion

The Committee's conclusions are applicable to people with type 2 diabetes who are overweight or obese and aim to reduce their energy intake. Based on the aforementioned findings, the Committee concludes that in order to promote long-term health, it sees no reason to recommend carbohydrate restriction to people with type 2 diabetes. However, the Committee also sees no reason to advise against it. Personalising nutritional advice based on, for example, preferences can help people adhere to a healthy dietary pattern.[53] People with type 2 diabetes can opt for carbohydrate restriction, though it must be noted that guidance from a dietician is preferred in this case.

Table 6 Overview of conclusions on the effects of a carbohydrate-restricted dietary pattern compared to higher-carbohydrate dietary pattern on health outcomes based on RCTs in people with type 2 diabetes.[a]

Health outcome[b]	Short-term effects[c] of very low and low-carbohydrate diets	Long-term effects[c] of very low and low-carbohydrate diets	Short-term effects of a moderate-carbohydrate dietary pattern	Long-term effects of a moderate-carbohydrate dietary pattern
HbA1c	Reduction of 0.36 to 0.49%; strong evidence	No difference	No difference	No difference
Body weight	*3 months*: Reduction of 2.5 kg; strong evidence *6 months*: No difference	No difference	No difference	Reduction of 0.6 kg; limited evidence
Fasting blood glucose levels	Reducing effect; limited evidence	Too little research	Too little research	Too little research
LDL cholesterol	No difference	Contradictory results	No difference	Contradictory results
Systolic blood pressure	Too little research	Too little research	Too little research	Too little research
eGFR	Too little research	Too little research	Too little research	Too little research

[a] More information on how the Committee reached these conclusions can be found in the background document *Reduced carbohydrate diets*.[52]

[b] The table lists the outcome measures for which (relevant) studies were found. For the outcome measures not shown in the table, no (relevant) studies were found.

[c] Short-term means: 3 to 6 months; long-term means: 1 year or more.

4.2.2 Points to consider with carbohydrate-restricted dietary patterns

The Committee has a number of concerns that are important when following a carbohydrate-restricted dietary pattern.

Professional guidance

It is recommended that carbohydrate-restricted dietary patterns, and very low or low-carbohydrate diets in particular, be followed only under the guidance of a dietician who can help ensure that the dietary pattern is healthy and complete.

Carbohydrate restriction and Dutch dietary guidelines

To promote long-term health, the Committee recommends to take into account the *Dutch dietary guidelines* in the compilation of carbohydrate-restricted dietary patterns. In this context, the Committee has identified two points that merit specific attention.

First, it recommends reducing carbohydrates by consuming fewer foods with added sugars, sugar-containing beverages and foods with refined grains, while opting for carbohydrate sources with sufficient dietary fibre, such as vegetables, fruit, whole grain foods and legumes. With carbohydrate restriction one's carbohydrate intake may namely lead to a decreased intake of dietary fibre. A diet low in dietary fibre is associated with a higher risk of chronic diseases, such as colon cancer, coronary heart disease and stroke.[54]

Secondly, the Committee recommends choosing good quality sources of protein and fat, such as fish, legumes, nuts and vegetable oils, as people on a carbohydrate-restricted diet will tend to eat relatively more fat and/or protein instead of carbohydrates. One concern, therefore, is that they may increase the intake of animal-based foods and saturated fat. In the short term, an increase in saturated fat intake can result in an increase in, among other things, LDL cholesterol, which increases the risk of coronary heart disease in the long term.[55] In its evaluation of carbohydrate-restricted dietary patterns, the Committee found heterogeneous effects on LDL cholesterol (favourable, neutral and unfavourable effects), which were probably caused, among other things, by differences in the macronutrients used to replace carbohydrates. It is known from studies in the general population that substituting carbohydrates with saturated fats increases LDL cholesterol while substituting them with unsaturated fats lowers LDL cholesterol.[56] Cohort studies in people with type 2 diabetes show that substituting carbohydrates with saturated fats is associated with a higher risk of cardiovascular disease (see Background document *Carbohydrate and fat substitutions*).[57]

Complete diet

It is important to consume a complete diet in order to prevent nutrient deficiencies. International intervention studies show that intakes of vitamin B1, folate, magnesium, calcium, iron, and iodine decreased in people who followed a carbohydrate-restricted diet for two weeks up to two years.[58] It is unknown whether a dietary pattern with a low or moderate quantity of carbohydrates will lead to certain micronutrient deficiencies (nutritional intake or nutritional status) in the Netherlands. This is not an easy question to answer, as carbohydrate-restricted dietary patterns can take many forms. Therefore, the Committee recommends calculating micro-nutrient intake when individual dietary advice is given on a carbohydrate-restricted dietary pattern, with a special focus on micronutrients from carbohydrate sources, such as iodine and vitamin B1.

Adjustment of diabetes medication

In general, with the use of medication that can lead to hypoglycaemia (such as sulphonylurea derivatives and insulin), the use of this medication should be adjusted to the amount of carbohydrates that are being consumed. Furthermore, people with type 2 diabetes who are prescribed SGLT-2 inhibitors, a relatively new class of blood glucose lowering drugs, warrant special attention. These people run a small risk of developing ketoacidosis with normal blood glucose levels (euglycaemia) if they use these drugs. Ketoacidosis is a metabolic state in which the body produces high levels of blood acids called ketones. This is a dangerous state and may prompt certain bodily functions to fail. Using SGLT-2 inhibitors while on a very low-carbohydrate diet (ketogenic diet) may increase the risk of ketoacidosis, as this diet stimulates ketone production.[59] Although the chance of this happening is probably small, the Committee recommends exercising caution with this combination.

05 recommendations

5.1 Dietary recommendations

The Committee has the following recommendations that are applicable to people with type 2 diabetes:

1. In the case of overweight and/or obesity, aim for at least 5% weight reduction and maintain this in the long term.
2. The *Dutch dietary guidelines* are a suitable basis for a healthy and varied dietary pattern for people with type 2 diabetes. The *Dutch dietary guidelines* are set out in the box below.
3. A carbohydrate-restricted dietary pattern may help achieve short-term weight reduction and improve glucose metabolism in people with type 2 diabetes who are overweight or obese, but it is not recommended to improve long-term health. This dietary pattern is also not discouraged for people with type 2 diabetes who are overweight or obese and aim to reduce their energy intake. Guidance from a dietician is preferable.

Dutch dietary guidelines 2015

Follow a dietary pattern that involves eating more plant-based and less animal-based food, as recommended in the guidelines:

- Eat at least 200 grams of vegetables and at least 200 grams of fruit daily
- Eat at least 90 grams of brown bread, wholemeal bread or other whole-grain products daily
- Eat legumes weekly
- Eat at least 15 grams of unsalted nuts daily
- Take a few portions of dairy products daily, including milk or yogurt.
- Eat fish weekly, preferably oily fish
- Drink three cups of tea daily
- Replace refined cereal products by whole-grain products.
- Replace butter, hard margarines, and cooking fats by soft margarines, liquid cooking fats, and vegetable oils.
- Replace unfiltered coffee by filtered coffee
- Limit the consumption of red meat, particularly processed meat.
- Minimise consumption of sugar-containing beverages.
- Don’t drink alcohol or no more than one glass daily.
- Limit salt intake to 6 grams daily.
- Nutrient supplements[a] are not needed, except for specific groups for which supplementation applies[b].

[a] The guideline on nutrient supplements concerns (multi)vitamins and minerals;

[b] For example, vitamin D supplements are recommended for various groups of people, such as 0 to 4-year-olds, women aged 50 and over, and everyone aged 70 and over.

5.2 Points of interest for professionals in implementing the recommendations

Below, the Committee outlines several points of interest for professionals who wish to incorporate its recommendations in nutritional information and nutritional care for people with type 2 diabetes.

5.2.1 Part of a multifactorial approach

The treatment of type 2 diabetes is multifactorial and promoting a healthy lifestyle is a major component of this multifactorial treatment. In addition to eating a healthy diet, a healthy lifestyle also includes getting plenty of exercise and not smoking, for example.[3] The Committee's recommendations should be incorporated into multifactorial treatment plans. Furthermore, the strive for weight loss in overweight and obese people with type 2 diabetes should be applied in a broad context of interventions aimed at weight reduction and weight maintenance[31,35-37], with the Committee's recommendations serving as a basis for dietary interventions.

5.2.2 The importance of a healthy, complete diet

In order to compile a healthy, complete diet, dietary recommendations from this advisory report should be combined with dietary reference values for nutrients and energy when these are translated to specific dietary advices for consumers. The Netherlands Nutrition Centre is responsible for disseminating information about healthy dietary patterns for the general population. To this end, the Netherlands Nutrition Centre has incorporated both dietary guidelines and dietary reference values established by the Dutch Health Council in its recommendations for a healthy, complete diet (the so-called 'Wheel of Five'), that matches the dietary habits of the Dutch population as much as possible. For people with chronic diseases, such as type 2 diabetes, the 'Wheel of Five' can also serve as a basis for a healthy and complete diet.

Dieticians, in cooperation with other healthcare professionals, can provide tailored dietary advice, for example on food quantities. In giving this advice, they can make use of the dietary guidelines and dietary reference values, and personal factors such as medication use and one's preferred body weight can be taken into account.

Dietary reference values are usually (but not exclusively) based on data obtained from healthy people. These reference values are generally also used for people with chronic diseases, unless professional associations have issued deviating recommendations. Based on its expertise, the Committee sees no objection to applying existing dietary reference values to people with type 2 diabetes. However, it cannot rule out that people with type 2 diabetes may, for some nutrients, have different requirements than healthy people.

As with the general population, it is preferable for people with type 2 diabetes to obtain all necessary nutrients through their diet, without taking dietary supplements. If this proves impossible, the treatment team may opt to test an individual's personal nutrient levels and advise them to take the necessary supplements.

5.2.3 Points of interest with regard to weight

The Committee recommends weight reduction for people with type 2 diabetes who are overweight or obese. Children and the elderly require special attention when attempting to lose weight. In children, growth must be taken into account. In the elderly, the consensus is that weight reduction should only be considered in cases of obesity, partly because there is also loss of bone and muscle mass during weight loss.[38]

When people aim to maintain their body weight or limit weight gain, it can be useful to pay attention to choices within the food groups on which the Committee advises. Full-fat dairy products contain more calories than semi-skimmed and skimmed dairy products, which may be a reason to opt for skimmed or semi-skimmed dairy products. Fresh fruit generally contains fewer sugars and therefore fewer calories than canned or jarred fruit with added syrup. Tea and filtered coffee without sugar as well as water are good alternatives to sugar-containing beverages in the context of the energy balance. The *Dutch dietary guidelines* recommend a minimum intake of nuts (i.e. no upper threshold). The Committee wishes to stress that nuts are relatively energy-dense foods and cannot be eaten in unrestricted amounts.

5.2.4 Points to consider with carbohydrate-restricted dietary patterns

For people with a preference for carbohydrate restriction, it is important to pay attention to the quality of the diet to promote long-term health. Therefore, the Committee recommends that the *Dutch dietary guidelines* are taken into account in the compilation of the carbohydrate-restricted dietary pattern. These can provide valuable assistance in choosing high-quality dietary sources of carbohydrates, such as vegetables, fruit and whole grain foods, and good-quality sources of fats and proteins. Carbohydrates should be limited mainly by reducing the intake of low-fibre, carbohydrate-rich foods, such as sugar-containing beverages and refined grain products. Cutting down on these foods is part of the *Dutch dietary guidelines* and is recommended for all people, including those with type 2 diabetes. It is important to ensure that the diet, whether carbohydrate-restricted or not, contains sufficient quantities of important nutrients, such as dietary fibre, vitamins and minerals. Therefore, the guidance of a dietician is preferable.

It is also important to adjust any diabetes medication to the amount of carbohydrates consumed in order to prevent hypoglycaemia.

5.3 Dietary recommendations for people with pre-diabetes

The current advisory report concerns people who have type 2 diabetes, and studies on people with pre-diabetes have not been evaluated for this report. Pre-diabetes is a preliminary stage of type 2 diabetes that involves impaired fasting glucose and/or impaired glucose tolerance. This means that blood glucose levels are elevated (in the fasting state and/or after a glucose tolerance test), but not yet as high as in people with type 2 diabetes. People with pre-diabetes have a high chance of developing type 2 diabetes. Approximately 30% of the general population aged 60 and over have impaired fasting glucose or impaired glucose tolerance.[3]

Several RCTs in people with pre-diabetes show that lifestyle interventions, that include targeting adaptations in dietary intake, can be very effective in this group. The studies showed that significantly fewer people in the life-style intervention groups developed diabetes and diabetes complications, even in the very long term (up to 20 years).[60-62] Based on this, the Committee concludes that there are relatively large health gains to be made in this group.

The Committee is of the opinion that there is no reason to deviate from the *Dutch dietary guidelines* for people with pre-diabetes. Firstly, because people with pre-diabetes, as they are part of the general population, are already included in the studies evaluated for the *Dutch dietary guidelines*. Secondly, because the dietary components of the mentioned lifestyle interventions were generally in line with the principles of the *Dutch dietary guidelines*.[60-62]

5.4 Recommendations for follow-up research

Based on its evaluation, the Committee makes a number of suggestions for follow-up research that may help to further specify and justify dietary recommendations for people with type 2 diabetes.

5.4.1 General foundation

For several guidelines of the *Dutch dietary guidelines*, the Committee found insufficient research to come to a conclusion, such as the guidelines for dairy products and sugar-containing beverages. The Committee is of the opinion that the existing guidelines are, for the time being, a good basis for people with type 2 diabetes. However, further research confirming (or disproving) this opinion is desirable. A future update of the *Dutch dietary guidelines* for the general population may also re-evaluate whether there are scientific reasons for adapting existing recommendations. At that time, the consequences of this update for the recommendations for people with type 2 diabetes can be re-evaluated.

5.4.2 Long-term effects

In its evaluation of carbohydrate-restricted dietary patterns, the Committee noted the studies showed there are no differences when comparing carbo-hydrate restriction for 12 months to other dietary patterns. There are

hardly any studies on the health effects over a period longer than one year. Participants also appeared to have difficulties in adhering to the dietary patterns studied in the long term. Research that can provide insight into how people with type 2 diabetes can adhere to a carbohydrate-restricted dietary pattern for an extended period of time in a healthy and complete way would be valuable. The effects on long-term health should also be taken into account.

5.4.3 Specific health outcomes

The studies evaluated by the Committee focused mainly on the relationship between dietary factors and the health outcomes 'all-cause mortality' and the 'development of cardiovascular disease', or on surrogate outcomes such as HbA1c. To the Committee's knowledge, little or no research has been done on the selected dietary factors in relation to other complications of diabetes, such as chronic kidney damage, neuropathy, retinopathy or infections. The Committee considers it important that more research is done into the relationship between dietary quality and the occurrence and course of these health outcomes in people with type 2 diabetes.

5.4.4 Specific groups

In this advisory report, the Committee concludes that the *Dutch dietary guidelines* are a suitable basis for the dietary pattern of all people with type 2 diabetes. Based on personal characteristics, there could be groups of people for whom specific adjustments to these guidelines could be recommended to further promote their health.[53,63] The Committee also investigated whether results in the reviewed studies are consistent in specific groups of people classified by gender, age or medication use, for example. However, there is currently too little research to make any statements on this.

5.4.5 Remission

Several studies indicate that type 2 diabetes could be reversed (diabetes remission) with dietary interventions in some people with type 2 diabetes,[34,64,65] possibly through weight loss.[34] However, based on the current state of scientific knowledge, the Committee could not draw any conclusions on the effects of the *Dutch dietary guidelines* and/or carbohydrate restriction, and their added value within a multifactorial lifestyle intervention, on diabetes remission. Further research is required.

5.4.6 Combined lifestyle interventions

A lot of research has already been done on the effects of combined lifestyle interventions, with the dietary components based on tailored general guidelines for a healthy diet, in people with pre-diabetes and/or overweight or obesity.[60-62,66-70] In such interventions, people get advice on and guidance with sustained healthy eating and physical activity. In some interventions, attention is also paid to sleep and stress. Several studies

show that long-term (up to 20 years) health gains can be achieved with combined lifestyle interventions in people with pre-diabetes.[60-62]

Combined lifestyle interventions for people who already have type 2 diabetes are becoming an increasingly popular research topic.[34,71,72] These studies generally report on shorter term health effects (not beyond 2 years). Research into the long-term effects of combined lifestyle interventions in people with type 2 diabetes, the dietary components of which are based on the *Dutch dietary guidelines*, is desirable, such as on weight maintenance and weight fluctuations. Research into how these interventions can be sustained in the long term is also desirable.

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Dutch dietary guidelines for people with type 2 diabetes

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