Guidelines for a healthy diet 2006

Gezondheidsraad
Health Council of the Netherlands

To the Minister of Health, Welfare and Sport

Subject : Guidelines for a Healthy Diet 2006
Your reference: GZB/VVB/98653
Our reference : U-1444/WB/ES/611-H
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Dear Minister,

Twenty years ago, the former Food and Nutrition Council produced the first edition of the *Guidelines for a healthy diet*. That publication formed the basis for subsequent food policy and for initiatives in the fields of food production and the dissemination of food-related information to the public. However, science has moved on since the report's appearance. Hence, the former State Secretary for Health, Welfare and Sport, acting partly on behalf of the former Minister of Agriculture, Nature and Food Quality, asked the Health Council to update the guidelines. I am now enclosing the Council's report, which has been compiled after consulting the Standing Committee on Medicine and the Standing Committee on Nutrition.

The new guidelines differ from the 1986 guidelines in a number of respects. For example, they contain advice not only for people whose body weight is normal and stable, but also for people whose weight is increasing undesirably or who are overweight. In addition, various guidelines have been translated into quantitative targets. The committee that compiled the report also wishes to emphasise that, for the purposes of disease prevention, the focus should be on overall dietary patterns rather than individual foods or food components. A good overall dietary pattern and adequate physical activity are among the preconditions for a long and healthy life.

P.O.Box 16052
NL-2500 BB The Hague
Telephone +31 (70) 340 71 80
Telefax +31 (70) 340 75 23
E-mail: ej.schoten@gr.nl

Visiting Address
Parnassusplein 5
NL-2511 VX The Hague
The Netherlands
www.healthcouncil.nl

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Finally, further to my letter dated 13 October 2005 (reference A-1182/DK/WB/mjv), I wish to stress the importance of the periodic National Food Consumption Surveys and the NEVO food composition table. On the basis of the information presented in these guidelines, I would also urge you to establish a periodic National Physical Activity Survey. Support for such surveys is necessary if good advice is to be provided regarding topical developments in the fields of nutrition and physical activity and their significance for public health.

Yours sincerely,

(signed)

Professor D. Kromhout,
Vice-president

P.O.Box 16052
NL-2500 BB The Hague
Telephone +31 (70) 340 71 80
Telefax +31 (70) 340 75 23
E-mail: ej.schoten@gr.nl

Visiting Address
Parnassusplein 5
NL-2511 VX The Hague
The Netherlands
www.healthcouncil.nl

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to:

the Minister of Health, Welfare and Sport

the Minister of Agriculture, Nature and Food Quality

No. 2006/21E, The Hague, 18 December 2006

The Health Council of the Netherlands, established in 1902, is an independent scientific advisory body. Its remit is "to advise the government and Parliament on the current level of knowledge with respect to public health issues..." (Section 22, Health Act).

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Contents

Executive summary

The *Guidelines for a healthy diet* are intended to support the food policy of the Dutch government and the monitoring of the impact of such policy. The guidelines also form the basis for nutrition education in the Netherlands. The previous version of *Guidelines for a healthy diet* appeared in 1986. The new guidelines reflect current scientific knowledge and thinking in this field.

Guidelines are intended for the apparently healthy population

The *Guidelines for a healthy diet 2006* are to a significant extent based on the conclusions of the various reports on diet-related matters and chronic disease risk that the Health Council has published in recent years. In this context, the reports on Recommended Dietary Allowances have been particularly influential. The review has also taken account of recent research data and dietary guidelines published by expert bodies in other countries. These guidelines are very consistent, with the emphasis on the prevention of overweight, cardiovascular diseases, type 2 diabetes mellitus and certain types of cancer. The guideline development process was also aided by a number of working conferences on particular topics.

The *Guidelines for a healthy diet 2006* apply to the apparently healthy Dutch population from the age of 12 months, i.e. the age at which infants begin to adopt an adult diet. For practical application, these guidelines need to be translated into quantitative advice on food consumption: the so-called *food-based dietary guidelines*. The process of translation needs to take account of ethnic differences in

dietary patterns, and the particular dietary needs of various population groups, such as children, pregnant women, the elderly and people with more or less physically active lifestyles. Also of relevance in this context is whether a person has an undesirable weight gain (positive energy balance) or overweight.

Both favourable and adverse dietary trends are evident

The report describes the average person's food consumption in the Netherlands in general terms and identifies significant trends. Both favourable and adverse dietary trends are discernible over the last few decades. The favourable trends include decreasing consumption of saturated and mono trans unsaturated fatty acids and cholesterol, and possibly a slight increase in fish consumption. Among the adverse trends identified by the Council is the declining consumption of fruit and vegetables. Furthermore, while recent data on sodium (salt) intake are scarce, there is reason to believe that the average person consumes too much salt. In addition, for many people the level of alcohol consumption is too high.

A healthy diet and sufficient physical activity result in a healthy energy balance

For reducing the risk of various chronic diseases, it is important that the low current average level of physical activity is increased by encouraging more people to meet the *Dutch Standard for Healthy Physical Activity* (Nederlandse Norm voor Gezond Bewegen). For adults, the recommendation is at least 30 minutes of moderate intensity physical activity – brisk walking, cycling, gardening, etc – at least five days a week, but preferably every day. Persons with undesirable weight gain or overweight, need to take more physical activity, at least an hour a day. Such people should also reduce their consumption of energy-dense foods as much as possible. The consumption of 'problem' foods in this regard are those high in saturated and mono trans unsaturated fatty acids and in added sugars (so-called 'empty calories'). They should replace energy-dense foods with nutrient-dense foods and high in dietary fibre. It is also advisable for these people to reduce their consumption of sugar-rich beverages, including sweetened tea and coffee.

Further change needed in the fatty acid content of the Dutch diet

To reduce the risk of coronary heart disease, further change is required in the fatty acid composition of the average person's diet, so that the guideline on

unsaturated fatty acid is met and the advisory limits on the intake of various types of saturated and mono trans unsaturated fatty acids are not exceeded. The average intake of saturated fatty acids in the diet needs to be cut from 13 to 14 per cent of energy intake to less than 10 per cent. Similarly, mono trans-fatty acid intake needs to be brought down from 1 to 2 per cent to less than 1 per cent. Meanwhile, the amount of fish fatty acids in the diet needs to be increased significantly before the advisory level of 450 milligrams per day is achieved. This level of intake equates to eating two portions of fish a week, including one portion of oily fish.

Increasing vegetable intake to 150 to 200 grams per day and fruit intake to 200 grams per day would boost the dietary concentration of essential micronutrients and improve the dietary sodium-potassium balance, thus helping to prevent high blood pressure. Moreover, this will reduce the risk of various chronic diseases. In order to reach the recommended dietary fibre intake of 3.4 gram per megajoule, the average person not only needs to eat more fruit and vegetables, but also should choose whole-grain cereal products ahead of refined products. Greater consumption of fruit, vegetables and whole-grain cereal products would also reduce dietary energy density, while increasing nutrient density; this would facilitate the maintenance of a healthy energy balance and bring other health benefits.

Limiting consumption of easily fermentable carbohydrates, salt and alcohol

Lower consumption of products containing easily fermentable carbohydrates and alimentary acids is also important for good dental health. For managing the risk of dental caries and dental erosion, it is advisable to limit the number of occasions that one eats or drinks such products to seven per day, including the three main meals.

The risk of high blood pressure may be reduced in various ways: by preventing overweight; by limiting alcohol consumption; by taking more physical activity; by reducing the amount of salt in the diet and increasing consumption of fruit, vegetables, low-fat dairy produce and whole-grain cereals. In this context, it is particularly important to reduce both the amount of salt people add to their food at home and the amount of salt added in the commercial production of foods and ready-to-eat meals.

People who consume alcohol are well advised to limit their intake; adult males should drink no more than two standard Dutch units per day, and adult women no more than one unit. Binge drinking should be avoided.

Emphasis on dietary pattern, not individual foods

The report emphasises that, in the context of diet-related chronic diseases, the focus needs to be on dietary pattern, not on individual foods or food components. The best way to reduce the risk of chronic diseases is to have a diet which is rich in fruit, vegetables, whole-grain cereal products and vegetable oils, which entails the regular consumption of fish and low-fat dairy and meat produce, and which is low in high energy-dense and low nutrient-dense foods, in combination with a physically active lifestyle, moderate alcohol consumption and abstinence from smoking.

Guidelines linked to body weight

The report includes the following *qualitative* guidelines on healthy eating for the general population, in the context of healthy lifestyle:

Ensure a varied diet.
Take adequate daily physical activity.
Eat plenty of fruit, vegetables and whole-grain cereal products every day.
Regularly eat (oily) fish.
Generally avoid products with a high level of saturated fatty acids and mono trans unsaturated fatty acids.
Avoid frequent consumption of foods or beverages that contain easily fermentable sugars and drinks that are high in alimentary acids.
Limit intake of salt.
If alcohol is used, do so in moderation.

The qualitative guidelines have been translated into the following *quantitative* targets for *adults* whose body weight is desirable and stable:

Take at least 30 minutes moderate intensity physical activity – brisk walking, cycling, gardening, etc – at least five days a week, but preferably every day.
Eat 150 to 200 grams of vegetables and 200 grams of fruit a day.
Eat 30 to 40 grams a day of dietary fibre, especially from sources such as fruit, vegetables and whole-grain cereal products.
Eat two portions of fish a week, at least one of which should be oily fish.
Limit saturated fatty acid consumption to less than 10 per cent of energy intake and mono trans-fatty acid consumption to less than 1 per cent of energy intake.
Limit consumption of foods and beverages that contain easily fermentable sugars and drinks that are high in food acids, to seven occasions a day (including main meals).
Limit consumption of table salt to 6 grams a day.
If alcohol is consumed at all, male intake should be limited to two Dutch units a day and female intake to one.

For other age groups also quantitative targets can be derived from the above. Alcohol consumption is inadvisable for the under-eighteens, and for pregnant women, women who are seeking to become pregnant and women who are breast-feeding.

The following additional guidelines apply to people with undesirable weight gain or overweight:

- *Take at least an hour's moderate intensity physical activity a day.*
- *Reduce energy intake, in particular by limiting:*
  - *Consumption of high energy-dense foods, i.e. products that are high in saturated and mono trans unsaturated fatty acids and added sugars (empty calories)*
  - *Consumption of sugar-rich beverages*
  - *Consumption of large portions.*

New guidelines differ from 1986 guidelines in various respects

The *Guidelines for a healthy diet 2006* differ from the 1986 guidelines in various respects. The new guidelines include quantitative recommendations on physical activity, for example, and distinguish between what is appropriate for people with undesirable weight gain or overweight and what is appropriate for other people. In contrast to the 1986 guidelines, the *Guidelines for a healthy diet 2006* also give quantitative advice on the consumption of saturated and mono trans-unsaturated fatty acids, on fish, fruit and vegetable consumption and moderate alcohol consumption.

On the other hand, the new guidelines do not specify recommended values for dietary cholesterol or for monosaccharides and disaccharides. A cholesterol limit was judged unnecessary, because a diet that is consistent with the fatty acid guidelines will also be relatively low in cholesterol; quantitative recommendations on the levels of monosaccharide and disaccharide consumption consistent with adequate nutrition and the prevention of chronic diseases have not been made, because insufficient scientific evidence is available to support firm conclusions.

Finally, compared with their predecessors, the new guidelines emphasise more explicitly that, for the prevention of diseases, the emphasis should be on dietary pattern, not on individual nutrients or foods.

A food and physical activity policy is needed to promote healthy eating and physical activity

The existence of evidence-based and practical guidelines does not automatically lead to people eating better or taking more physical activity. Other factors need to be in place to bring such changes about. The government has at its disposal various policy instruments that may be of use in this context, including issuing of rules, nutrition education, the educational promotion of healthy lifestyle choices, and the conclusion of voluntary agreements with the business community. The latter community itself has scope for action, including the development and modification of products in line with the dietary recommendations contained in this report. Furthermore, product labelling could be improved to provide consumers with adequate and accessible information about the energy and nutrient content of food products.

Chapter 1

Introduction

1.1 Background

The original *Guidelines for a Healthy Diet* were produced by the former Food and Nutrition Council in 1986.[1] The guidelines described the average daily diet in the Netherlands and set out the changes that the Food and Nutrition Council saw as desirable for the prevention of 'traditional' deficiency diseases, cardiovascular diseases, cancer, type 2 diabetes mellitus, hypertension, obesity, osteoporosis and dental caries.

Over the years, the 1986 guidelines have been updated in the light of scientific developments on several occasions. So, for example, the guideline on fat consumption shifted from the moderation of total fat intake to the moderation of saturated fat intake. In addition, greater emphasis was placed on the consumption of oily fish (i.e. fish rich in n-3 fatty acids).

On the basis of the *Guidelines for a Healthy Diet*, the Netherlands Nutrition Centre drew up the *Spelregels voor een goede voeding* (*Recommendations for a Healthy Diet*) for use in the context of public information campaigns. The latter document contained quantitative advice in the form of the so-called *Food-Based Dietary Guidelines*.

1.2 The request for advice and the committee

Acting partly on behalf of the former Minister of Agriculture, Nature and Food Quality, the former State Secretary for Health, Welfare and Sport asked that the dietary guidelines should be reviewed every five years in the light of the latest scientific thinking and developments, and updated as necessary (see Annex A). On 29 November 2004, Professor J.G.A.J. Hautvast, who was Vice-President of the Health Council at that time, accordingly established the Committee on Guidelines for a Healthy Diet (referred to below simply as 'the Committee'). The composition of the Committee is specified in Annex B.

1.3 Structure of this report

The remaining pages of this introduction describe the approach taken by the Committee and the way in which the research findings have been assessed. Chapter 2 consists of a general description of the average Dutch person's diet and how it has developed in recent times. Chapter 3 addresses the factors that influence the energy balance. Chapter 4 explains how a person's diet influences his/her risk of chronic disease. In chapter 5, consideration is given to a number of foods and dietary patterns that are important in relation to reducing the risk of diet-related chronic disease. Chapter 6 identifies the dietary changes that may be considered desirable in the light of the latest scientific thinking and developments. The report concludes in chapter 7 with a number of recommendations regarding food policy, which implementation of the *Guidelines for a Healthy Diet 2006* may be expected to support.

1.4 Approach and accounting

1.4.1 Basis of the report

This report is based upon the conclusions and recommendations contained in other reports on aspects of diet, which the Health Council has published in recent years:

- Reports on dietary reference intakes:
  - Calcium, vitamin D, thiamine, riboflavin, niacin, pantothenic acid and biotin (2000)[2]
  - Energy, proteins, fats and digestible carbohydrates (2001)[3]
  - Vitamin B_6, folic acid and vitamin B_{12} (2003)[2]

  - Guideline on Dietary Fibre Intake (2006)[4]
- The report Salt and Blood Pressure (2000)[5]
- The report Significant Trends in Food Consumption in the Netherlands (2002)[6]
- The report Overweight and obesity (2003)[7]
- The report Risks of Alcohol Consumption related to Conception, Pregnancy and Breastfeeding (2004).[8]

PubMed was used to establish whether further research data had been published since the completion of the above reports, which might justify revision of their conclusions or recommendations. Particular consideration was given to overviews, structured reviews, meta-analyses and the results of randomised controlled intervention studies. Thus, account was taken of academic literature published up to spring 2006. Furthermore, use was made of recent reports published by similar expert committees responsible for the preparation of dietary advice for the public in other countries. PubMed was also used for targeted literature searches in connection with a number of matters, which were not thoroughly covered by the earlier Health Council reports or concerning which updated data were required. The Committee undertook background studies into: appropriate levels of physical activity; the significance of monosaccharides and disaccharides and added sugar in the diet; dental erosion; moderate alcohol consumption; fruit and vegetable consumption; dietary cholesterol; sodium and high blood pressure; fluid requirements; glycaemic index; n-3 fatty acids from fish. For the topics physical activity, fruit and vegetable consumption and the advisable intake of n-3 fatty acids from fish, the Committee set up workshops with appropriate experts. The participants in these workshops are listed in Annex C. The results of the background studies and workshops are described in the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

1.4.2 Assessment of research findings

The present dietary reference intakes were drawn up with a view to the prevention of not only traditional deficiency diseases, but also chronic diseases. In most cases, the relationship between a food and the risk of a chronic disease is deduced from the effect of that food on an intermediate outcome (a biomarker or risk factor).

In this context, the Dietary Reference Intakes Committee has taken the following into account when considering the strength of evidence for the existence of an association:

- The type of research from which the data originate, in descending order of evidential significance:
  - Intervention studies with human subjects, with morbidity or mortality as the outcome indicator
  - Intervention studies with human subjects, with an intermediate biomarker or risk factor as biomarker
  - Prospective cohort studies
  - Case-control, cross-sectional and migrant studies
  - Ecological studies, individual case histories and research based on animal experiments
  - *In vitro* studies
- The strength of the association
- The consistency of the association (whether results from other studies of the same type or another type support the findings)
- The presence or absence of a dose-effect relationship

The dietary reference intakes devised by the Dietary Reference Intakes Committee are based mainly on the results of intervention studies and prospective (cohort) studies. Data from studies of other types have been used only for support.

The Committee has classified possible associations between diet and the risk of chronic diseases as follows:

- *Convincing:* Epidemiological research has produced evidence of a consistent association between exposure and disease and few if any studies have failed to find evidence of the association. A similar effect has been observed in a substantial number of studies, including prospective observational cohort studies and (where possible) randomised controlled studies of adequate size, duration and quality. The observed association is biologically plausible.
- *Probable:* Epidemiological research has produced evidence of a largely consistent association between exposure and disease, but individual studies have limitations* or the findings have been contradicted by a small number of studies, making it impossible to draw a more definitive conclusion. The asso-

* E.g. insufficient study duration, insufficient number of studies, insufficiently large research populations, inadequate follow-up.

ciation is biologically plausible and its existence generally corroborated by the results of (animal) experimental research.
- *Insufficient evidence:* A small number of studies have produced findings that, although suggestive of an association between exposure and disease, do not convincingly demonstrate such an association. Few if any of the relevant data come from randomised controlled studies. Alternatively, the evidence comes largely from case-control studies and cross-sectional studies and little of it from randomised controlled trials, non-randomised controlled trials or observational studies. Under such circumstances, a suggested association is regarded as unproven even if clinical research or experimental research (possibly with animals) has produced supportive findings and/or is biologically plausible. Hence more research is needed before any firm conclusion may be drawn regarding the observed possible association.

The three categories of evidence were defined by reference to the criteria applied by the Joint WHO/FAO Consultation on Diet, Nutrition and the Prevention of Chronic Diseases[10]. However, the criteria used by the WHO/FAO expert committee to confirm the existence of a 'possible association' have been incorporated by the Committee responsible for this report into its 'insufficient evidence' category. The import of the criteria in question is consistent with those applied by the Dietary Reference Intakes Committee. Almost all the suggested associations upon which the recommendations of this report are based come under the category 'probable'.

1.4.3 *Nature and target group of the guidelines*

The *Guidelines for a Healthy Diet 2006* are intended primarily to support the development of food policy and the monitoring of its effects. The quantified objectives set out in the guidelines enable policy makers to compare actual population food consumption patterns with the target situation. The quantified objectives are expressly applicable to the general population. They relate to the optimal diet for public health, in terms of both composition and quantity.

The guidelines apply to apparently healthy members of the Dutch population from the age of twelve months, i.e. the age at which infants begin to adopt an adult diet. Thus, the Committee supports the conclusion that the Food and Nutrition Council drew in its 1992 report *Te hanteren leeftijdsgrens met betrekking tot het advies Richtlijnen goede voeding* (*The Appropriate Age Threshold for Application in the context of the Guidelines for a Healthy Diet*)[11]. Separate dietary guidelines for infants and toddlers have been produced under the auspices of the

Netherlands Nutrition Centre. The scientific merit of those guidelines has recently been assessed by the Health Council*.

The dietary guidelines produced by expert committees in western industrialised countries are largely consistent with one another. They are intended mainly to prevent overweight, cardiovascular disease, type 2 diabetes mellitus and certain types of cancer. However, some do include quantitative objectives for salt and (added) sugar intake, while others do not.

Practical application of the *Guidelines for a Healthy Diet 2006* depends on their translation into appropriate quantitative intake advice, known as food-based dietary guidelines. In this context, it is important to take account of differences in the food patterns of various ethnic groups, and of the differing needs of various population subgroups, such as children, pregnant women, older people and those with low, moderate and high physical activity levels. The existence of a positive energy balance also needs to be considered.

One of the principles underpinning the *Guidelines for a Healthy Diet 2006* is that a supply of essential nutrients should be obtained primarily by the consumption of 'ordinary' foods. However, this is not or may not be possible where iodine, folic acid**, vitamin D*** and retinol equivalents are concerned. At the request of the Minister of Health, Welfare and Sport, a Health Council committee is presently preparing a report on this issue.

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* Health Council. Guidelines for the Diet of Infants and Toddlers. The Hague: Health Council 2006: Nr 2006/20.
** In connection with the prevention of neural tube defects.
*** Young children and older people.

Chapter 2

Developments in food consumption

Developments in food consumption in the Netherlands have been extensively described in the Health Council report *Significant Trends in Food Consumption in the Netherlands*[6] and the RIVM report *Our Food, Our Health*[12]. These developments are summarised below.

2.1 Developments in the consumption of various foods

The third National Food Consumption Survey, carried out in 1997/98, established the levels of consumption of various groups of foods within the general population. The trends between 1987/88 and 1997/98 were also charted:

Table 1 Consumption of various groups of foods, as reported in the food consumption survey 1997/98*.

	Mean ± SD in grams/day	Trend 1997/98 vs. 1987/88
Potatoes	114 ± 93	Declining
Bread	135 ± 72	Declining
Alcoholic drinks	159 ± 358	Declining
Non-alcoholic drinks	1194 ± 644	Rising strongly
Eggs	14 ± 21	Declining
Fruit	105 ± 14	Declining
Cake and biscuits	41 ± 42	Declining
Cereal products and thickeners	44 ± 72	Rising
Vegetables	123 ± 95	Declining strongly

Savoury sandwich fillings	3	±	8	Stable
Cheese	27	±	29	Stable
Milk and dairy products	383	±	262	Rising
Nuts, seeds and snacks	29	±	41	Rising
Legumes	5	±	24	Declining
Ready-to-eat meals	28	±	75	Rising strongly
Soups	67	±	120	Declining
Sugar, confectionary, sweet spreads & sweet	41	±	37	Declining
Fats, oils and savoury sauces	48	±	37	Rising
Fish	10	±	31	Stable[a]
Meat, meat products and poultry	109	±	71	Declining

[a] Fish consumption rose slightly in the period under consideration, but the rise was not statistically significant.

* Source: Hulshof et al.[13], Health Council.[6]

In the period 1987/88 to 1997/98, the average consumption of staple foods, such as bread, potatoes, vegetables, fruit and meat declined. The strongest decline observed was in the consumption of vegetables. In 1997/98, less than a quarter of the population over the age of 12 ate 150 to 200 grams of vegetables, as recommended by the Netherlands Nutrition Centre. By contrast, consumption of cereal products other than bread, milk and dairy produce, nuts and snacks, ready-to-eat meals and non-alcoholic drinks all increased. Consumption of ready-to-eat meals and non-alcoholic drinks rose particularly sharply.

Average fish consumption levels remained stable or rose very slightly in the period 1987/88 to 1997/98. However, the average person did not eat fish often (two or three times a month); only about a quarter of the population ate fish at least once a week. In the MORGEN Project, which provides a picture of usual long-term food intake, 10 per cent of the adult men surveyed in 1996 reported never eating fish*. Recent domestic sales data suggest that the average consumption of fish has recently increased slightly.[12]

The changes in the average consumption of staple foods were most pronounced in people aged less than 40.

2.2 Developments in nutrient intake

According to the third National Food Consumption Survey in 1997/98, the macronutrient content of the average Dutch diet and the trend in the period 1987/88 to 1997/98 was as follows:

* Unpublished data from RIVM's Netherlands Health Risk Factor Monitoring Project (personal communication with Hulshof KFAM). For information on the consumption of fish, see subchapter 3.4 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

Table 2 Average nutrient intake according to the food consumption survey 1997/98*.

Energy and macronutrients	Mean ±	SD	Trend 1997/98 v. 1987/88
Energy (MJ)	9,2 ±	2,9	Declining
Protein (en%)	14,8 ±	3,4	Rising
Fat (en%)	35,9 ±	6,7	Declining
Saturated fatty acids (en%)	14,2 ±	3,3	Declining
Mono-trans-unsaturated fatty acids (en%)	1,7 ±	1,0	Strong declining
Mono-cis-unsaturated fatty acids (en%)	12,6 ±	2,9	[a]
Poly-cis-unsaturated fatty acids (en%)	6,8 ±	2,4	[a]
Digestible carbohydrates (en%)	46,6 ±	8,2	Rising
Monosaccharides and disaccharides (en%)	23,3 ±	8,1	Rising
Dietary fibre (g) *(g/MJ)*	21 ±	8,0 (*2,3 ± 0,8*)	Stable
Cholesterol (mg) *(mg/MJ)*	206 ±	22,6 *(22,6 ± 10,4*)	Declining
Alcohol (en%)	2,6 ±	4,8	Stable

[a] Overall consumption of cis-unsaturated fatty acids is rising as a percentage of energy intake.
* Source: Hulshof e.a.[14], Health Council.[6]

Although the energy value of the average diet in the period 1987/88 to 1997/98 fell by 4 per cent, the number of people who were overweight or obese actually went up in this period. The Committee that compiled the report *Significant Trends in Food Consumption in the Netherlands* assumed that this was because energy consumption through physical activity fell between 1987/88 and 1997/98 even more than the energy value of the average person's food intake.

The amount of total fat in the national diet and the fatty acid composition of fat changed for the better between the two surveys. There was a particularly sharp decline in mono-trans-unsaturated fatty acid consumption, associated mainly with a reduction in the concentration of mono-trans-unsaturated fatty acids in (partially) hydrogenated vegetable oils. The less marked fall in saturated fatty acid consumption appears to be attributable to the substitution of high-fat products from the 'oils, fats and savoury sauces', 'milk and dairy products' and 'meat, meat products and poultry' categories by lower-fat alternatives.

Nevertheless, saturated fat still accounted for more than 10 per cent of energy intake in the diet of 95 per cent of the population. The average person's consumption of unsaturated fat (20 per cent of energy intake) was broadly consistent with the recommendations of the Dietary Reference Intakes Committee.

The amount of (n-6) fatty acids (linoleic acid) in the national diet seems to be adequate. However, reliable data on α-linolenic acid consumption were not available*. From what is known about average fish consumption, it follows that the amount of n-3 fatty acids from fish in the national diet was well below the dietary reference intake.

Only 17 per cent of the population consumed the recommended 3 grams or more of dietary fibre per megajoule of energy intake. Declining consumption of bread, potatoes, fruit and vegetables means that for many people it is increasingly difficult to get the fibre that they need.

In 1997/98, only 1.8 per cent of the population had a diet consistent with all the recommendations made in *Guidelines for a Healthy Diet 1986.*

In the period between 1987/88 and 1997/98, the nutrient density** of the national diet declined. On average, micronutrient*** intake was lower, although not to a particularly worrying extent. Folic acid consumption does warrant attention, however. Research into folic acid status has revealed that, if maintenance of an optimal serum homocysteine level is taken as indicative of a healthy folic acid status, 60 per cent of the adult population had a suboptimal folic acid status in the period 1990 to 1993.[16] Falling vegetable consumption has been unhelpful in this regard.

Average iron intakes were below the dietary reference intake, particularly where women of childbearing age were concerned, and fell in the period 1987/88 to 1997/98. However, research into the iron status of the adult population in the period 1990 to 1993 suggested that low or suboptimal iron status was not widespread at that time.[17]

No recent data are available on salt consumption, which can shed much light on the average intake in the Netherlands. The 24-hour sodium excretion levels of 190 Dutch participants in the EPIC calibration study conducted between 1995 and 1997 indicate an average sodium intake of 3.9 grams a day.[18] This equates to consumption of nearly 9.8 grams of salt a day.

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* Some information is available from the Transfair Study. The average intake of α-linolenic acid is 1 to 2 grams a day (roughly 0.5 per cent of energy intake).[15]

** Amount of essential micronutrients per unit of energy.

*** Essential micronutrients for which Health Council/Food and Nutrition Council dietary reference intakes have been defined and whose concentration in various foods is specified in the NEVO food composition table. Iodine, for example, is not included.

2.3 National Food Consumption Survey 2003

In 2003, the food consumption of young adults (19-30-year-olds) was surveyed.[19] The key findings of the survey are summarised in chapter 1 of the *Background Document to the Guidelines for a Healthy Diet 2006*.[9] Since the structure and methodology of the 2003 survey differed from earlier food consumption surveys, the results cannot properly be compared across time.[19] Nevertheless, the results of the 2003 survey confirm the picture revealed by the earlier surveys in terms of fat intake, the fatty acid make-up of the national diet and fruit and vegetable consumption. It may also be concluded that, in 2003, there were substantial discrepancies between the diet of the average young adult and the recommendations concerning intake of saturated fatty acids and dietary fibre and the consumption of fish, fruit and vegetables.

2.4 Conclusion

The Committee observes that over recent decades the Dutch national diet has changed in various respects, some favourable and others unfavourable. The falls in consumption of saturated fatty acids, mono-trans-unsaturated fatty acids and cholesterol and the possible slight increase in fish consumption may be regarded as positive developments. However, declining consumption of fruit and vegetables is undesirable.

Chapter 3

Factors that influence the energy balance

In this chapter we consider the factors that influence the energy balance: the various foods that provide energy, and physical activity by which energy is consumed.

3.1 Energy balance

One's energy balance is neutral if the body is using the same amount of energy as is taken in in the form of food. Dietary energy intake and physical activity-related energy consumption should be balanced in such a way as to maintain the Body Mass Index (bodyweight in kilos divided by height squared in metres) at between 18.5 and 24.9 kg/m*.[2,7]

If dietary energy intake exceeds usage, a person is said to have a 'positive energy balance'. In this context 'positive' does not imply 'favourable', but is indicative of an energy surplus. A person whose energy balance is positive will gain weight, because the body stores the excess energy as fat, thus potentially leading to overweight and obesity.

The health risks associated with obesity (BMI > 30 kg/m^2) are well documented; those associated with mere overweight (BMI: 25-29.9 kg/m^2) much less so. One of the first consequences of weight gain is insulin resistance, a condition in which the effect of insulin is compromised. Insulin resistance plays a key role

* This guideline applies to adults. The healthy BMI range is different for growing children and older people.[7]

in the development of so-called metabolic syndrome: a condition characterised by a variety of related abnormalities, such as insulin resistance, dyslipidaemia and high blood pressure. These abnormalities can in turn lead to type 2 diabetes mellitus and the associated complications, such as cardiovascular diseases. Other health risks associated with obesity include colon and gall bladder cancer, hormone-related forms of cancer, bilious conditions, arthrosis, respiratory problems, gout, infertility, menstrual problems and foetal abnormalities.[7]

3.2 Physical activity

Sustainable weight regulation and realisation of the associated public health objectives depends on addressing both energy intake and energy expenditure. The maintenance of a neutral energy balance requires dietary energy intake to be consistent with energy expenditure. Hence, recommendations regarding dietary energy intake must always be linked to recommendations regarding daily physical activity levels. Furthermore, physical activity influences the risk of various diet-related chronic diseases. Physical activity increases the amount of HDL cholesterol in the blood, reduces blood pressure, heart rate and blood platelet aggregation, decreases the blood triacylglycerol concentration and enhances insulin sensitivity. It is therefore important that the *Guidelines for a Healthy Diet 2006* include advice on appropriate levels of physical activity.

In defining a level of physical activity that may be expected to reduce the risk of cardiovascular diseases, high blood pressure, type 2 diabetes mellitus and certain types of cancer, the Committee has chosen to follow the Dutch Standard for Healthy Physical Activity.[20] It is recommended that an adult (aged 18-55) gets at least half an hour of moderately strenuous physical activity at least five days a week, but preferably every day. Depending on age, the intensity of this activity should be sufficient to induce 4-6.5 times the resting metabolic rate (4-6.5 MET)*. This level of intensity is consistent with, for example, brisk walking (5 kilometres an hour), cycling (16 kilometres an hour) or gardening. However, the report *Overweight and Obesity* concluded that this level of physical activity was not sufficient to prevent undesirable weight gain in the general populace.[7]

According to the report, maintenance of a healthy weight requires an hour's moderately strenuous physical activity a day. People need to incorporate physical activity into their normal daily routine by, for example, taking the stairs instead of the elevator, walking or cycling to work and going for a brisk daily walk. It

* MET = metabolic equivalent. Brisk walking (4-5 MET), cycling (4-6 MET), swimming (6-8 MET), climbing stairs and jogging (8 MET), playing sports such as tennis and volleyball (6-8 MET), gardening average 4-5 MET.

was also suggested that recreational sports participation could further promote energy consumption and prevent the development of a positive energy balance.

3.3 Energy-providing macronutrients

In 2001, the Dietary Reference Intakes Committee drew up recommendations regarding the proportion of dietary energy intake that should be obtained from each of the three macronutrients (proteins, fats, carbohydrates) [3]:

Table 3 Breakdown of adult energy intake by macronutrient type.

Nutrient	Recommended amount/adequate intake as percentage of total energy intake	
	People without a weight problem	People who are overweight or gaining weight undesirably
Proteins[a]	10	10
Fats	20-40	20-30 to 35
Digestible carbohydrates	40	40
Total	70-90	70-80 to 85

[a] The recommended amount for adults varies, depending on age and gender, from 8 to 11 per cent of energy intake.

The sum of the dietary energy contributions made by proteins, fats and digestible carbohydrates is by definition 100 per cent. However, it will be noted that the figures quoted in the above table do not total 100 per cent. The remainder of the energy required may be obtained by increasing the intake of proteins or digestible carbohydrates above the recommended level, provided that the dietary energy contribution made by proteins does not exceed 25 per cent. The acceptable variation in contributions is detailed in the following table:

Table 4 Acceptable variation in the contribution to dietary energy intake made for each macronutrient.

Nutrient	Acceptable variation in contribution to dietary energy intake	
	People without a weight problem	People who are overweight or gaining weight undesirably
Proteins	10-25	10-25
Fats	20-40	20-30 to 35
Digestible carbohydrates	40-70	40-70

In practice, however, some of the additional energy required will usually be obtained from alcohol. The National Food Consumption Survey of 1997/98 indicated that alcohol accounted for 3 to 5 per cent of the dietary energy intake of the average adult.[6]

If a person's diet does not include the three macronutrients in the recommended proportions, he or she is theoretically at increased risk of an essential micronutrient deficiency.

However, a carefully planned diet, which includes foods with a high nutrient density and a low energy density*, and which provides adequate essential micronutrients, may not provide sufficient energy for a person with a particular activity pattern. Such an individual may compensate the energy shortfall by eating foods that provide energy without necessarily contributing essential nutrients to any significant extent. The amount of energy that a person may sensibly obtain from a source or sources of his/her choice is known as his/her discretionary energy intake**.[21] The level of a person's discretionary energy intake increases in line with his/her level of physical activity and thus with his/her energy requirement. Taking more physical activity is therefore an important means of increasing the discretionary element of one's diet ***.

In some cases, a physically inactive person's diet may include staple foods that contribute both essential micronutrients and large amounts of the energy, due to a high concentration of 'empty calories' (added sugars, saturated and mono-trans-unsaturated fatty acids). Such a person's energy needs may be met before he or she has consumed sufficient essential nutrients.

3.4 Dietary factors influencing the energy balance

3.4.1 Proteins

Of all the energy-providing nutrients, protein has the greatest saturating effect. The report Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates states that insufficient data are available to support a conclusion as to whether and, if so, how the amount of protein in the diet influences the energy balance.[3] Furthermore, the report Overweight and Obesity, which appeared in 2003, does not identify the amount of protein in the diet as a factor influencing the risk of overweight.[7]

Nevertheless, the results of recent controlled studies suggest that a higher proportion of protein in the diet suppresses hunger and leads to sustained inhibition

* Energy density: amount of energy per unit weight of food and drink, excluding sugar-free soft drinks, (mineral) water, coffee and tea.

** Energy intake that is not necessarily associated with essential micronutrient intake and may therefore be obtained from a source or sources of choice.

*** Increasing dietary energy intake does somewhat increase the need for vitamins that play a role in energy metabolism.

of *ad libitum* energy intake.[22-26] The effect of low-carbohydrate diets – such as the Atkins diet, the Zone diet and the South Beach diet – on the energy balance may therefore be attributable not to their low carbohydrate concentration, but to their high protein content. However, the underlying mechanism is not clear. A meta-analysis of the results of various controlled studies suggests that protein increases thermogenesis more than fat or carbohydrates.[22] The implications for the energy balance are modest, however. In a critical review, Halton concludes that the available research findings justify the replacement of products rich in simple carbohydrates with products that have high protein and low saturated fat content, in order to reduce the risk of a positive energy balance developing.[22]

The Committee would emphasise that the significance of dietary protein intake for the prevention of undesirable weight gain has yet to be scientifically investigated. The Committee takes the view that there is not currently sufficient reason to believe that the reference protein intake should be revised in the interests of overweight prevention.

3.4.2 *Fats*

The reports Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates and Overweight and Obesity pay considerable attention to the influence that the amount of fat in the diet has on the energy balance, a question which has been examined in various prospective observational and randomised controlled studies.[3,7] These reports conclude that, if a person's energy balance is neutral, the energy-providing macronutrients can be interchanged at will without any effect on the energy balance. However, if there is a positive energy balance, a diet that contains a lot of fat is more likely to cause further weight gain than a low-fat diet. The likelihood of passive energy over-consumption is greater with a high-fat diet, which will generally have a higher energy density and a lower volume than a low-fat diet.

This is apparently because, in the short term, the saturating effect of fat is less than that of proteins or carbohydrates, resulting excessive energy intake. A lower-fat diet (30-35 per cent of energy intake from fat, as opposed to the usual 40 per cent) can therefore help people who are overweight or gaining weight undesirably to neutralise their energy balance.[7]

Willett et al. published a review, which reported that most of the studies which had yielded evidence that a lower fat intake resulted in a lower energy intake were of relatively short duration.[27] According to these authors, no association between the amount of fat in the diet and bodyweight is discernible from randomised controlled studies lasting more than a year. The assertion is that, over

time, people gradually increase their consumption of other energy-providing nutrients to compensate for the reduction in energy intake brought about by a lower fat intake. These authors also point out that none of the randomised controlled trials that have looked at the effect on bodyweight of the iso-energetic substitution of energy-providing foods have found any evidence that fat consumption has a specific effect on bodyweight. They therefore argue that the amount of fat in the diet is not the primary reason for the high prevalence of overweight and obesity in many countries.

A recent analysis of the results of the US Women's Health Initiative Dietary Modification Trial found no evidence that a relatively low-fat diet (one in which fat accounts for 30 per cent of energy intake, as opposed to 39 per cent or so) led to weight loss (or, indeed, weight gain) among postmenopausal women during a follow-up period averaging 7.5 years.[28]

Although no consensus exists regarding the significance of the amount of fat in the diet in relation to energy balance maintenance, the Committee currently aligns itself with the conclusion contained in the reports *Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates* and *Overweight and Obesity:* a high-fat diet more easily leads to passive over-consumption of energy and is therefore more likely to be associated with a positive energy balance. Hence, people who are overweight or gaining weight undesirably can benefit from a diet in which the amount of fat is limited to not more than 30 to 35 per cent of energy intake.

3.4.3 Digestible carbohydrates

Carbohydrates regulate hunger better than fats, so a carbohydrate-rich diet is less likely to lead to a positive energy balance than a fat-rich diet.

The report *Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates* concluded that the amount of carbohydrate in the diet did not influence weight, provided that energy intake was in line with energy expenditure. According to the report, there is no convincing evidence that the type of carbohydrate (monosaccharides and disaccharides versus polysaccharides) is relevant in this context.[3]

By contrast, some expert committees in other countries have advocated the moderation of sugar consumption – particularly added sugar consumption – as a means of preventing overweight and have recommended maximum intake quantities. However, the Committee does not believe that there is sufficient scientific evidence to support quantitative guidance on monosaccharide and disaccharide intake or on the amount of added sugar in the diet. There is nevertheless good

reason to suggest that people whose energy balance is positive should limit their added sugar intake as far as possible. This topic is considered more closely in subchapter 5.2.1.

In the context of energy balance maintenance, it is apparently important whether sugar is ingested in solid food or in a drink. According to the report *Overweight and Obesity*, the evidence then available suggested that the consumption of soft drinks easily led to a positive energy balance without the person having any sense of overeating.[7] This topic is considered in more detail in subchapter 5.3.

3.4.4 *Glycaemic index*

The report Overweight and Obesity concluded that there is no consensus as to whether the glycaemic index of foods is significant in the context of energy balance maintenance.[7] The Committee believes that this conclusion remains valid. The influence of glycaemic index on saturation and weight regulation remains unclear, because very few studies have looked at blood glucose levels, hunger and food intake in combination. Furthermore, the findings of those studies that have done so have not been consistent [*]. In the Committee's view, the evidence for an association between glycaemic index and weight regulation remains unconvincing.

3.4.5 *Dietary fibre*

The report Overweight and Obesity also concluded that a high-fibre diet was probably advantageous in terms of energy balance maintenance.[7] However, there are no scientific data from which the ideal dietary fibre concentration for energy balance maintenance may be calculated. Nor is it possible to distinguish adequately between the effects of the various types of dietary fibre. The recently published Guideline for Dietary Fibre Intake states that a high-fibre diet is important for the prevention of excessive weight gain. However, like the report Overweight and Obesity, the guideline concludes that it is not possible to quantify the ideal intake on the basis of the research data currently available [**].[4] The Committee endorses these conclusions and takes the view that a diet that is high in dietary fibre is probably significant in the context of weight regulation.

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* See chapter 8 Background Document to the Guidelines for a Healthy Diet 2006.[9]

** The WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases takes the view that the positive effect of dietary fibre on energy balance maintenance has been convincingly demonstrated.[10]

3.4.6 *Alcohol*

Whether and, if so, to what extent alcohol consumption makes a positive energy balance more likely is unclear according to the report Overweight and Obesity.[7] The body gives priority to the oxidation of alcohol, with the result that the oxidation of energy-providing macronutrients (particularly fat) is inhibited. Although there are signs that moderate alcohol consumption can facilitate the development of a positive energy balance, the research findings do not present a clear picture.[29] In two recent reviews, Yeomans has contended that alcohol increases the risk of a positive energy balance developing through the active and passive overconsumption of energy.[30,31] This author concludes that people do not compensate for energy intake from moderate alcohol consumption by eating less at other times. Furthermore, alcohol consumption appears to stimulate short-term hunger.

Recent randomised controlled trials, in which alcohol was found to have a dose-dependent effect on hunger and food intake, supports these conclusions.[32] In animal research, however, compensation for alcohol-derived energy intake has been observed.[33]

The US National Institute on Alcohol Abuse and Alcoholism is of the opinion that the inconsistent research findings do not support any conclusion regarding the association between moderate alcohol consumption and the risk of overweight and obesity.[34] While sharing this view, the Committee does not consider it likely that moderate alcohol consumption, as defined in subchapter 5.7, facilitates the development of a positive energy balance under normal circumstances.

3.4.7 *Calcium and dairy products*

The report Overweight and Obesity cited evidence that calcium and dairy products had a positive effect on weight regulation and concluded that further research was needed in order to properly assess the significance of the findings in question.[7] Since the report's publication, additional information has become available.

In a randomised, placebo-controlled study of obese adults (n=32), calcium suppletion and the consumption of dairy products as part of a low-energy diet were both found to have a positive effect on weight reduction after 24weeks.[35] The effect of dairy product consumption was significantly greater than that of calcium suppletion. In 2005, the same research group published the findings of a twelve-week randomised placebo-controlled study of obese adults (n=34), which indicated that yogurt consumption in the context of a low-energy diet had a posi-

tive effect on the degree of weight loss.[36] However, when 135 healthy young women of normal bodyweight were monitored for a year in a randomised controlled study, a high-dairy (calcium) diet had no observable effect on weight regulation.[37] This results suggest that calcium or dairy products may have an effect on weight regulation by helping to establish a negative energy balance.

A recent analysis of the results of the Health Professionals Follow-up Study revealed that the level of calcium intake or dairy product consumption had no influence on weight change in men over a period of twelve years.[38]

In the Committee's view, the recently published research findings do not justify revision of the conclusion drawn in the report *Overweight and Obesity*. The mechanism by which calcium and dairy products might influence energy regulation remains uncertain. Nor is it clear whether the observed effects are actually attributable to the calcium or to certain bioactive substances present in dairy products.

3.5 Overall food intake level

3.5.1 Energy density

The water content and fat content of a food are the main factors influencing its energy density. High-fat foods generally have a high energy density. Research has established a positive association between the percentage of energy contributed by fat and energy density, both where individual foods are concerned and where overall diet is concerned. By contrast, the association between the percentage of energy contributed by carbohydrates and energy density was found to be negative.[39] The effect of the energy density of individual foods on the energy balance maintenance is therefore complex.[40] For example, the high water content of sugar contianing (soft) drinks means that their energy density is low, while milk – because of its carbohydrate, protein and fat contents – has a somewhat higher energy density. As a rule, foods with a high dry substance content have a high energy density, unless they contain a lot of non-digestible carbohydrate.

According to the WHO/FAO Expert Consultation on Diet, Nutrition, and the Prevention of Chronic Diseases, there is convincing evidence that frequent consumption of energy dense foods increases the risk of developing a positive energy balance (and thus becoming overweight).[10] However, the Nordic Council of Ministers and the US Dietary Guidelines Advisory Committee 2005 take the view that insufficient clear scientific data are available to quantify the contribution that the consumption of energy dense foods makes to the risk of a positive energy balance.[21,41] In the report *Overweight and Obesity*, the Health Council

states that the higher the energy density of one's food*, the greater one's energy intake will be and the more likely a positive energy balance will be.[7]

The Committee is of the opinion that the extent to which the consumption of high-energy-density foods contributes to the risk of developing a positive energy balance cannot presently be determined. Nevertheless, in light of the research data currently available, the Committee considers it probable that a diet with a high energy density increases the likelihood of a positive energy balance developing.

3.5.2 *Portion size*

Snack and meal portion sizes are also significant in the context of energy balance maintenance. The report Overweight and Obesity stated that there was reason to believe that larger portions led to greater energy intake.[7] Although at the time of the report's publication such an association appeared both very likely and plausible, there was little firm evidence for it in the form of results from high quality studies. Since then, however, the results of controlled studies among children, adolescents and adults have been made available, which confirm that, where (packaged) snacks, meals and meal components are concerned, larger portions and higher energy density lead to unintentionally raised energy intake and thus increase the risk of developing a positive energy balance.[42-51]

A recent controlled *cross-over* study of twenty-four young women of normal bodyweight in the USA found that reducing habitual portion size and energy density (usually by reducing the fat content) independently and collectively cut *ad libitum* energy intake over a period of two days without increasing the subjects' sense of hunger.[52] Reducing the energy density of a food had no effect on the amount of it that was eaten. Energy density changes had a greater effect on energy intake than portion size changes.

Although most of the research into the association between portion size and the risk of positive energy balance development has been carried out in the USA, the Committee sees no reason to believe that the findings are not valid for the Netherlands as well. Nevertheless, the Committee shares the view of the Nordic Council of Ministers and the US Dietary Guidelines Advisory Committee 2005 that there are currently insufficient data available to quantify the influence of portion size on the risk of positive energy balance development.[21,41]

* Calculated as the megajoules of energy per unit weight of food, excluding water and other non-energy-providing drinks.

3.5.3 *Meal frequency*

The report Overweight and Obesity[7] concluded that the significance of meal frequency for energy balance maintenance was not clear. Nevertheless, the report's authors considered it likely that frequent consumption of energy-rich snacks increased the likelihood of a positive energy balance developing. No further relevant research data have since been published; the Committee accordingly takes the view that the report's conclusion remains valid.

Chapter 4

Diet and chronic diseases

A proper diet reduces the risk of chronic diseases. To explain this phenomenon, the influence of each nutrient on a number of chronic diseases is considered below.

4.1 Proteins

In the Health Council's 2001 report *Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates*, the association between the amount of protein in the diet and the risk of chronic diseases is explored. Since the report's publication, new research findings have been published concerning the relationship between protein intake and a number of diseases, but none give grounds for revision of the Council's earlier conclusions.

4.1.1 Coronary heart disease

In 2001, the Health Council concluded that protein intake probably had no effect on the risk of coronary heart disease. It has since been suggested that the substitution of protein for carbohydrates has a positive effect on the blood lipoprotein pattern.[53] However, the relevant findings are by no means conclusive and no long-term studies have been conducted. The Committee therefore endorses the conclusion of the 2001 report.

4.1.2 *Cancer*

On the basis of a literature survey published by the World Cancer Research Fund in 1997, the Council concluded in 2001 that it was unlikely that the amount of protein in the diet influenced the risk of cancer. No new research data have since been made available that would justify revision of this conclusion.

4.1.3 *Osteoporosis*

In the reports Prevention of Osteoporosis-Related Fractures[54] and Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates[3], the Council has previously highlighted research findings suggesting that a high-protein diet may be conducive to osteoporosis, because of the raised calcium excretion such a diet induces. The two reports also stated that it appeared from other studies that a low protein intake had a negative effect on bone health as well, and increased the risk of fractures. In neither case, however, was the evidence sufficient to support any definite conclusion regarding the significance of protein intake in relation to the development of osteoporosis.

In a recent review article, Bonjour emphasised the importance of adequate protein intake for healthy bones and the prevention of osteoporosis.[55] This author highlighted the results of numerous experimental and clinical studies, which had suggested that a low-protein diet had a negative influence on bone health. Furthermore, the results of various large-scale observational studies published since 2001 have revealed an inverse association between protein intake and the risk of hip fracture. Nevertheless, the Committee does not believe that the new information warrants adjustment of the dietary reference intake for protein with a view to preventing osteoporosis.

4.1.4 *Kidney disease*

It has long been suspected that high protein consumption impairs kidney function. This suspicion is based on the observation that people with kidney disease benefit from reducing the amount of protein in their diet. However, the 2001 report Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates concluded from the data then available that protein intake probably did not influence the risk of developing kidney disease.[3] No further research data have since become available that might support revision of this conclusion.

4.2 Total fat and fatty acid composition

The Health Council's 2001 report *Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates* included the following recommendations regarding the amount and type of fat in the adult diet:

Table 5 Adequacy ranges for adult intake of total fat and fatty acids.

Total fat (en %)	20-40	neutral energy balance
	20-30 to 35	positive energy balance
Linoleic acid (en %)	2	
α-linolenic acid (en %)	1	
(n-3) fatty acids in fish[a] (mg)	200	
Cis-unsaturated fatty acids (en %)	8-38[b]	neutral energy balance
	8-28/33[b]	positive energy balance
Saturated fatty acids (en %)	As low as possible	acceptable upper limit 10% of energy intake
Mono-trans-unsaturated fatty acids (en %)	As low as possible	acceptable upper limit 1% of energy intake

[a] n-3 fatty acids from fish
[b] theoretical maximum

The evidence available at the time of the report's publication suggested that a diet that included the indicated amount of fat, with fatty acids in the proportions indicated, probably made the most positive contribution to a person's risk profile. In other words, the recommended fat intake pattern was expected to minimise the risk of developing diet-related chronic diseases. These dietary reference intakes were based on extensive literature studies, taking in reports published by similar expert committees in other countries.[56-58] The information that has subsequently become available regarding the influence of dietary fatty acid composition on the risk of chronic diseases is summarised in the following subchapters.

4.2.1 Coronary heart disease

Conclusions of the 2001 report

On the basis of an analysis of the research data available at the time the report *Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates* draws the following conclusions regarding the prevention of coronary heart disease:[3]

- Compared with cis-unsaturated fatty acids, saturated fatty acids increase the risk of coronary heart disease by adversely influencing the balance between total and HDL serum cholesterol.
- Mono-trans-unsaturated fatty acids increase the risk of coronary heart disease by having an adverse effect on the lipoprotein concentrations in the blood (raising LDL serum cholesterol, reducing HDL serum cholesterol and increasing the ratio between the two). Mono-trans-unsaturated fatty acids have a greater adverse effect than saturated fatty acids. This conclusion was based mainly on research with mono-trans-unsaturated fatty acids. The report indicated that not enough was known about the significance of poly-trans-unsaturated fatty acids for the risk of coronary heart disease to support any definitive conclusions.
- Substitution of poly-cis-unsaturated fatty acids for saturated fatty acids reduces the risk of coronary heart disease.
- (N-3) fish oil fatty acids reduce the risk of coronary heart disease; eating one portion of fish per week appears sufficient to obtain this effect.
- α-linolenic acid probably protects against coronary heart disease.
- In view of their influence on the blood lipoprotein pattern, and in comparison with saturated fatty acids, mono-cis-unsaturated fatty acids probably reduce the risk of coronary heart disease. However, scientific evidence is not as strong as that regarding the influence of poly-cis-unsaturated fatty acids*. It was not therefore possible to make a recommendation specifically regarding mono-cis-unsaturated fatty acids.
- In people whose energy balance is neutral, increasing total dietary fat content and decreasing dietary carbohydrate intake has a favourable effect on the HDL serum cholesterol and triacylglycerol levels in the blood. The type of fatty acid involved makes little difference in this context. Saturated fatty acids have a less favourable effect on the total serum cholesterol and LDL serum cholesterol levels than carbohydrates. By contrast, cis-unsaturated fatty acids have a more favourable effect than carbohydrates. Provided that the fatty acid proportions are favourable, an iso-energetic increase in the amount of fat in the diet and a corresponding reduction in the amount of carbohydrate lead to a positive shift in the lipoprotein concentrations in fasting blood.

* No intervention studies have been conducted using coronary heart disease as a clinical outcome.

Recent research findings

The results of major prospective epidemiologic studies that have become available since 2001 support the view that, for the prevention of coronary heart disease, the total amount of fat in the diet is less important than the types of fatty acid concerned.[21,59]

The results of the meta-analysis by Mensink et al., which sought to quantify the effects of the various types of fatty acid on the ratio between total serum cholesterol and HDL serum cholesterol, are consistent with the conclusions of the Council's 2001 report, as described above. The results of this meta-analysis, which took in the results of 60 controlled studies,[60] indicate that the substitution of carbohydrates for saturated fatty acids does not influence the ratio between serum total and HDL cholesterol. The ratio can be reduced, however, by substituting poly-cis-unsaturated fatty acids for saturated fatty acids. Mono-trans-unsaturated fatty acids have a pronounced negative effect on the ratio. Of the saturated fatty acids, lauric acid (C12:0) appears to raise the total serum cholesterol level most when substituted for carbohydrates. However, lauric acid reduces the ratio between total serum cholesterol and HDL serum cholesterol. In other words, the rise in the total cholesterol level is due mainly to a higher HDL serum cholesterol level. Hence, fats that are rich in lauric acid have a favourable effect on the ratio. Nevertheless, the possibility that lauric acid has some other adverse influence on the risk of coronary heart disease cannot be excluded. Myristic acid (C14:0) and palmitic acid (C16:0) have little effect on the ratio between serum total and HDL cholesterol, while stearic acid (C18:0) reduces the ratio slightly. Poly-cis-unsaturated fatty acids (linoleic acid) appear to have a slightly more favourable effect on the ratio than mono-cis-unsaturated fatty acids (oleic acid).

The meta-analysis also showed that the substitution of carbohydrates for saturated fatty acids led to an equally great rise in serum triacylglycerol concentration, regardless of the saturated fatty acid involved.

A small number of publications have appeared, in which the source of mono-trans-unsaturated fatty acids is considered as a determinant of coronary heart disease risk. Most of the fatty acids of this type eaten by humans come from industrially (partially) hydrogenated vegetable oils (in particular elaidic acid) and to a lesser extent from the meat and milk fat of ruminants (in particular vaccenic acid). The results of various prospective epidemiological cohort studies and case-control studies conducted in the 1990s pointed to a positive association between the risk of coronary heart disease and consumption of trans-unsaturated fatty acids from industrially (partially) hydrogenated vegetable oils, although no com-

parable association was found where mono-trans-unsaturated fatty acids of animal origin were concerned.[61-63] However, other prospective studies failed to detect any difference in the influence that the two varieties of trans-unsaturated fatty acids have on the risk of coronary heart disease.[64,65] Following their recent analyses of the available scientific data, both Weggemans and Mensink conclude that prospective epidemiological research does not yet provide sufficient evidence to be sure that mono-trans-unsaturated fatty acids of animal origin are more benign in terms of their influence on the risk of coronary heart disease than similar fatty acids from industrially hardened vegetable oils.[66,67] The Committee endorses this conclusion, but would point out that there has not yet been any intervention studies with humans. Without such studies, it is not possible to draw any definitive conclusion regarding the significance of the source of mono-trans-unsaturated fatty acids for coronary heart disease risk.

The Committee would also highlight the fact that since 2001 research findings have also been published, suggesting that mono-trans-unsaturated fatty acids have an adverse effect not only on blood lipoprotein pattern, but also on other factors determining the risk of coronary heart disease. It appears that the risk of coronary heart disease associated with consumption of mono-trans-unsaturated fatty acids is greater than might be expected merely from their effect on blood lipoproteins.[67,68]

Poly-trans-unsaturated fatty acids are isomers of conjugated linoleic acid, which is found mainly in milk fat. These isomers can vary markedly in terms of their physiological influence, complicating interpretation of the results of research into the effects of these fatty acids. Animal research has indicated that this group of fatty acids has an effect on blood lipoproteins. However, such findings have not been adequately corroborated by studies in humans.[69] Pending any evidence to the contrary, the Committee considers it unlikely that poly-trans-unsaturated fatty acids have any significant influence on the blood lipoprotein patterns. The Committee thus aligns itself with the conclusion drawn by the US Institute of Medicine's Panel on Macronutrients.[58]

The n-3 long-chain fatty acids in fish oil (EPA and DHA*) have only a modest effect on serum cholesterol levels (their influence being neutral to adverse). Nevertheless, fatty acids of this type have been observed to have a favourable effect on other cardiovascular disease risk factors, such as arrhythmias, serum triacylglycerol concentration, the vessel wall (endothelium) function, inflammation and

* EPA: eicosapentaenoic acid; DHA: docosahexaenoic acid.

coagulation.[70] Consumption of these fatty acids mainly influences the risk of mortality associated with acute coronary death in people who have previously suffered a myocardial infarction. This effect is attributed primarily to the fatty acids' anti-arrhythmic properties. There is also evidence that n-3 fatty acids from fish reduce the risk of brain infarction*. The Committee considers the evidence regarding the effects of fish oil fatty acid consumption on blood pressure insufficient to support any firm conclusion.

He et al. performed a meta-analysis of data from prospective cohort studies and found strong evidence of an inverse association between the consumption of fish and mortality due to coronary heart disease.[71] This observation was confirmed by another meta-analysis of Bucher et al., which used data from randomised controlled intervention trials of coronary patients to explore the relationship between n-3 fatty acid intake and mortality.[72] A further meta-analysis of cohort study findings by He and co-workers again revealed an inverse association between the intake of fish and the risk of stroke.[73] Hooper et al. recently carried out a pooled analysis, using the results of 41 cohort studies and forty-eight randomised controlled interventional studies. However, they were unable to discern any clear association between the intake of long-chain n-3 fatty acids and overall mortality or the risk of cardiovascular diseases.[74] It should be noted this analysis has been criticised by numerous authors.[75,76] Various possible causes of the discrepancy may be identified. For example, the analysis by Hooper et al. involved data from diverse studies and examined the joint effect of fish oil fatty acid and α-linolenic acid on mortality risk and the risk of cardiovascular diseases. However, the epidemiological research evidence that α-linolenic acid is beneficial is significantly less persuasive than that concerning the effect of n-3 fatty acids from fish. No randomised controlled intervention trials have yet been published.[77] In their systematic review of the results of studies in both patients and non-patients, Wang et al. report finding no evidence that α-linolenic acid consumption influences the risk of cardiovascular diseases (see below).[78] Furthermore, the results of the pooled analysis were strongly influenced by the results of the DART-2 Study**.[79] As indicated in subchapter 3.2.1 of the *Background Document to the Guidelines for a Healthy Diet 2006*, the quality of this randomised controlled intervention study is subject of debate. If the results of that study are excluded from the Hooper analysis, an inverse association emerges between n-3 long-chain fatty acid consumption and the risk of cardiovascular diseases, similar to that obtained by Bucher et al.[72] A recent systematic review of the results of

* See chapter 3 *Background Document to the Guidelines for a Healthy Diet 2006.*[9]
** DART = Diet and Reinfarction Trial.

numerous randomised controlled studies and prospective cohort studies and a few case-control studies involving both cardiovascular disease patients and people without such condition provided further support for an inverse association between fish consumption, fish oil fatty acid intake and the risk of cardiovascular diseases, as identified by the He and Bucher meta-analyses.[78] This analysis indicated that the positive effect of fish and fish oil fatty acid consumption on rates of overall mortality and mortality due to myocardial infarction, sudden coronary death and stroke was stronger among known cardiovascular disease patients than among populations free of such condition.

New research findings

The research results released since the publication of the report *Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates* (2001) suggest that the present Dutch dietary reference intake for n-3 fatty acids from fish is on the low side. The present figure of 200 milligrams a day was formulated partly with a view to minimising the risk of cardiovascular diseases. The Committee believes that the research data now available support raising the reference level to 450 milligrams a day*. This equates to eating two portions of fish a week, at least one of them being a portion of oily fish (assuming a portion size of 100 to 150 grams. (See also subchapter 5.8.)

On the basis of the scientific data available at the time, the Council's 2001 report concluded that α-linolenic acid probably had a specific protective effect against coronary heart disease.[3] This conclusion has recently been corroborated by the results of a meta-analysis of data from a prospective cohort study, which showed that α-linolenic acid is associated with a lower coronary heart disease risk.[80]

However, another recent systematic review (by Wang et al.) of the results of numerous randomised controlled studies and prospective cohort studies and a few case-control studies involving both cardiovascular disease patients and people without such condition failed to find any evidence that α-linolenic acid had an effect on the risk of cardiovascular diseases.[78] The Committee accordingly believes that further research is needed before a definitive conclusion may be drawn concerning the effect of α-linolenic acid on the risk of cardiovascular diseases.

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* See chapter 3 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

4.2.2 *Type 2 diabetes mellitus*

Conclusions of the 2001 report

The report *Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates* drew the following conclusions regarding the association between consumption of fat/fatty acids and the risk of type 2 diabetes mellitus:[3]

- It is likely that reducing the total dietary fat intake reduces the risk of developing type 2 diabetes mellitus. A low-fat diet appears to promote glucose tolerance and insulin sensitivity.
- Insufficient data are available to support any conclusion regarding the influence of saturated fatty acids on the risk of developing type 2 diabetes mellitus.
- Insufficient data are available to support any definitive statement regarding the significance of mono-trans-unsaturated fatty acids in relation to the risk of type 2 diabetes mellitus .
- The risk of type 2 diabetes mellitus is probably not influenced by dietary intake of poly-cis-unsaturated fatty acids. Insufficient data are available to support any conclusion regarding the significance of the various types of unsaturated fatty acids.
- The effect of mono-cis-unsaturated fatty acids on the risk of developing type 2 diabetes mellitus is unclear. The research findings are inconsistent, with no effect found in some cases and an increased risk in others.

New research findings

The Committee does not believe that the recently published research findings[81-87] warrant any revision of the conclusions presented in the Council's 2001 report. The WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases does consider it probable that saturated fatty acid consumption leads to an increased risk of type 2 diabetes mellitus.[10] However, the Committee takes the view that there is not yet sufficient evidence for an association between the fatty acid composition of the diet and the risk of developing type 2 diabetes mellitus to support a quantitative recommendation. Although there is increasing evidence to suppose that saturated fatty acids have a negative effect on insulin resistance, while cis-unsaturated fatty acids have a positive effect, this has still to be confirmed by controlled intervention trials .

4.2.3 *Cancer*

Conclusions of the 2001 report

The report *Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates* drew the following conclusions regarding the association between consumption of fat/fatty acids and the risk of cancer:[3]

- Total dietary fat intake has no effect, or at most a marginal effect, on the risk of breast cancer and probably no effect on the risk of colon or prostate cancer.
- Linoleic acid intake probably does not influence cancer risk.
- The possibility that high α-linolenic acid intake increases the risk of prostate cancer cannot be excluded. However, the evidence for any such association remains insufficient to support a firm conclusion.
- Although there are some grounds to suggest that n-3 long-chain fatty acids from fish protect against breast and colorectal cancer, the findings are not sufficiently consistent to support a definite conclusion.
- It is unclear to what extent mono-cis-unsaturated fatty acids influence cancer risk; the relevant findings are mutually contradictory.
- Data from case-control studies suggest that saturated fatty acids may increase the risk of breast cancer in postmenopausal women. This was not confirmed, however, by the results of prospective cohort studies. Since such studies carried greater evidential weight than case-control studies, it seems unlikely that saturated fatty acids increase breast cancer risk. Much the same may be said concerning the risk of colorectal and prostate cancer.
- Insufficient research data are available to support any definitive statement concerning the role of mono-trans-unsaturated fatty acids in the development of cancer.

Recent research data

As indicated in the 2001 report, the evidence for an association between the total dietary fat intake and the risk of developing certain types of cancer is not convincing. In 2003, meta-analysis of 23 case-control studies and 12 prospective cohort studies of the relationship between fat intake and breast cancer risk was published. This revealed a relative risk of 1.13 for total fat intake and 1.19 for saturated fat intake.[88] In the Netherlands cohort study on the relationship between diet and cancer, no association was found between total dietary fat intake and breast cancer risk in postmenopausal women.[89] Where saturated fat

was concerned, a weak positive association was observed, but it was not statistically significant.

Since 2001, further research findings have become available, which shed new light on the relationship between α-linolenic acid and the risk of prostate cancer. A meta-analysis of nine cohort studies and case-control studies calculated that the relative risk of prostate cancer was greater (relative risk 1.7 (95 per cent reliability interval: 1.12 to 2.58)) for men in the group with the highest α-linolenic acid intake (an average of 800 milligrams a day) or the highest α-linolenic acid concentration in the blood, than it was for men in the group with the lowest intake (an average of 200 milligrams a day) or the lowest blood concentration*.[80] The causality of this association has been questioned, however.[21, 90-92]

Following a structured analysis of the results of 20 cohort studies conducted in seven different countries and published in the period 1966 to October 2005, MacLean et al. concluded that there was insufficient evidence to say that a significant association exists between the intake of n-3 long-chain fatty acids** and the incidence of eleven forms of cancer, including breast cancer and colorectal cancer.[93] Furthermore, the recently published results of Hooper et al's pooled analysis of 48 randomised controlled studies and 41 prospective cohort studies revealed no association between fish oil fatty acid intake (from fish consumption or capsule use) and the risk of cancer.[74]

New research findings

The evidence that recent studies and data analyses provide for an association between the amount of (saturated) fat in the diet and the risk of breast cancer is not in the Committee's view strong enough to warrant revision of the conclusion of the Council's 2001 report. Other expert committees that have recently published dietary guidelines have reached similar conclusions.[10,21,41] A similar position is taken with regard to a possible association between α-linolenic acid intake and the risk of prostate cancer, and with regard to the influence of mono-trans-unsaturated fatty acids, cis-unsaturated fatty acids and CLAs.***[89] In view of the research data currently available, the Committee also concludes that an association between fish oil fatty acid intake and the risk of cancer is improbable.

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* DHA, EPA, α-linolenic acid and fish consumption.

** These research findings had not been published at the time of the 2001 report, but were known to the committee that compiled the report *Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates*. Hence they were taken into account when the committee formulated its conclusion regarding the relationship between α-linolenic acid and the risk of prostate cancer.

*** CLAs: Conjugated Linolenic Acids

4.2.4 *Immune system (inflammatory response)*

The report Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates indicated that more research was required before conclusions could be drawn regarding the possible effects of n-3 fatty acids on the immune system.

Since the report came out in 2001, various studies have been published, suggesting that n-3 fatty acids may have an anti-inflammatory effect. Thus, these acids can influence conditions characterised by inflammatory response (e.g. rheumatoid arthritis and Crohn's disease) or involving inflammatory response (e.g. asthma and atopic dermatitis). However, the size and quality of these studies has been such that they cannot support any definitive statement on this effect.

The conclusion regarding n-3 fatty acids drawn in the Council's 2001 report therefore remains valid in the Committee's view.

4.2.5 *Other diseases and conditions*

The report Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates did not address the possibility that n-3 fatty acids from fish might have a positive effect on ADHD, antisocial behaviour and depression.

Since the reported effects have generally been obtained by suppletion in quantities that far exceed the intake that one might achieve through a normal diet, such effects are also outside the scope of the current report.

The Zutphen Study has produced evidence to suggest that a high intake of linoleic acid is positively associated with the risk of impaired cognitive function, while high fish consumption reduces this risk.[94] Another prospective cohort study has found that fish consumption can inhibit the deterioration of cognitive function in older people.[95]

An analysis of the results of the Rotterdam Study after a follow-up of more than two years has suggested that high levels of total fat and saturated fat intake increase the risk of dementia, while high consumption of fish reduce the risk.[96] However, analysis after a six-year follow-up detected no association between total fat intake, or intake of the various types of fatty acid, and the risk of dementia.[97]

The Committee considers the available research data too sparse and mutually contradictory. No judgement may yet be made, therefore, regarding the significance of dietary fat intake, or the proportional intake of the various fatty acids, for the risk of developing dementia.

4.3 Dietary cholesterol

Dietary cholesterol raises the LDL serum cholesterol level and the total serum cholesterol level, thus increasing the risk of coronary heart disease. The effect of dietary cholesterol is not as great as that of saturated fatty acids or mono-trans-unsaturated fatty acids, however. There appears to be an S-shaped association. At the intake levels typical in the Netherlands, a dose-response relationship may usually be observed. However, epidemiological research examining the effect of dietary cholesterol intake on coronary heart disease risk factors has produced inconsistent results. This inconsistency may be attributed to various factors, varying from methodological shortcomings to the wide between-person variation in blood lipoprotein pattern response to dietary cholesterol*. Willett's research group has concluded from the most recent large-scale prospective observational studies that no significant association may be observed between dietary cholesterol intake and coronary heart disease risk.[98] Earlier research did find evidence of such an association, however.[99]

The *Guidelines for a Healthy Diet 1986* recommended that, with a view to minimising the risk of coronary heart disease, dietary cholesterol intake should be limited to the average at that time, i.e. 33 milligrams per megajoule**.[1] In this context, other expert committees have advised restricting dietary cholesterol intake to anything from 'the minimum possible' to 300 milligrams a day. The food consumption surveys indicate that average dietary cholesterol intake in the Netherlands in 1997/98 was roughly 200 milligrams a day (see subchapter 2.1.2): considerably less than the maximum acceptable level of 300 milligrams a day specified by the US Dietary Guidelines Advisory Committee 2005 and others.[21]

Various other expert committees that have drawn up dietary guidelines have opted not to give specific advice on dietary cholesterol intake. A diet that is high in cholesterol will generally be high in saturated fat as well***. Reduction of the amount of saturated fat in the diet may therefore be expected to result in lower cholesterol intake. The Committee accepts this principle and – considering also the relatively low average cholesterol content of the Dutch diet – concludes that it is unnecessary to give quantitative advice on dietary cholesterol intake.

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* See chapter 4 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

** According to this report, the energy value of the average male diet was then 11.5 MJ, while that of the average female diet was 9 MJ. Intakes of, respectively, appr. 380 milligrams and appr. 300 milligrams were therefore considered acceptable.

*** Excluding eggs and offal.

4.4 Digestible carbohydrates

In the following subchapters, consideration is given to the association between digestible carbohydrate intake and the risk of coronary heart disease, type 2 diabetes mellitus, cancer and dental caries.

4.4.1 Coronary heart disease

Conclusions of the 2001 report

The report Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates drew the following conclusions:[3]

- Compared with the intake of fats with an ideal fatty acid composition, the intake of carbohydrates has an adverse effect on the lipoprotein fractions in fasting blood, but favourable effects on the triacylglycerol concentration in non-fasting blood and on the factor VII concentration in both non-fasting and fasting blood.
- The significance of the glycaemic load for coronary heart disease risk remains unclear. There is no convincing evidence that consumption of particular types of digestible carbohydrate is associated with coronary heart disease risk.

Recent research data

All experts agree that cutting the amount of saturated fat in the diet reduces the risk of coronary heart disease. Disagreement exists, however, as to which macronutrient should be substituted for saturated fat: carbohydrates, proteins or cis-unsaturated fatty acids. The substitution of carbohydrates for saturated fat has an adverse influence on certain aspects of the blood lipoprotein pattern. Of particular significance in this regard are a fall in the HDL serum cholesterol level and a rise in the triacylglycerol concentration in fasting blood, which increase the risk of coronary heart disease. A growing number of authors have accordingly argued that saturated fatty acids should be substituted by (mono-)cis-unsaturated fatty acids, rather than by carbohydrates.[60, 100-102]

Sacks and Katan analysed the results of numerous randomised controlled intervention trials, which had investigated the effect of fat intake, the intake of different types of fat and carbohydrates intake on the risk of cardiovascular disease.[102] They concluded that the substitution of carbohydrates for saturated fat

resulted in equally marked declines in the HDL serum cholesterol level and the LDL serum cholesterol level. Mensink et al.'s meta-analysis of data from 60 randomised controlled interventional studies found that the substitution of carbohydrates for saturated fat did not lead to a change in the ratio between total serum and HDL cholesterol.

By contrast, substitution of cis-unsaturated fatty acids for saturated fat resulted in a reduction of this ratio and thus in a reduction in the risk of coronary heart disease. These authors conclude that the overall effect of carbohydrate substitution for saturated fat on the risk of coronary heart disease is unclear.[60]

From the OmniHeart Study – a randomised cross-over dietary study – it is apparent that partial substitution of mono-cis-unsaturated fatty acids for carbohydrates has a positive effect on blood pressure and blood lipoprotein profile, thus reducing the risk of coronary heart disease.[103] The Committee would point out that this study involves iso-energetic substitution, with subjects remaining at a constant weight. Whether the observed effects would be replicated in 'real life' circumstances, where people are not obliged to adhere to a diet calculated to keep their body weight constant, is unclear.

New research findings

On the basis of the scientific data presently available, the Committee concludes that the substitution of carbohydrates for saturated and mono-trans-unsaturated fatty acids has a less favourable effect on the ratio between total serum cholesterol and HDL cholesterol than the substitution of cis-unsaturated fatty acids. Although such substitution may in the long term lead to weight gain, the net effect on the risk of coronary heart disease is positive*.

The *Guidelines for a Healthy Diet 1986* advised that monosaccharide and disaccharide intake should account for 15 to 25 per cent of total energy intake. The Committee undertook a background study to establish the extent to which present knowledge supported the definition of a limit on dietary monosaccharide and disaccharide intake to prevent coronary heart disease**. It was concluded that the available data did not provide an adequate basis for the definition of a limit for this purpose.

The Committee also considered whether recent research findings warranted revision of the conclusion drawn in the Council's 2001 report*** concerning the

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* Zock, P.L. Do favorable effects of increasing unsaturated fat intake on CVD risk outweigh the potential adverse effect on body weight? Int J Obes (2006)30, S10-S15.

** See chapter 5 of the *Background Document to the Guidelines for a Healthy Diet 2006*. [9]

*** See chapter 8 of the *Background Document to the Guidelines for a Healthy Diet 2006*. [9]

significance of glycaemic load for the risk of coronary heart disease. It was concluded that no such revision was necessary. The available evidence is not sufficiently consistent to support general recommendations regarding dietary glycaemic load or regarding the glycaemic index of individual foods or the overall diet.

4.4.2 *Type 2 diabetes mellitus*

The report Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates concluded that, while a high carbohydrate intake might be beneficial in relation to glucose tolerance and insulin sensitivity, there was insufficient evidence to conclude that a high-carbohydrate diet could reduce the risk of type 2 diabetes mellitus.[3] According to the report there was also insufficient evidence that the various types of carbohydrate differed in their effect on glucose tolerance and the risk of type 2 diabetes mellitus . The report's authors also took the view that glycaemic load and the average dietary glycaemic index did not influence the risk of type 2 diabetes mellitus . Having considered the recent research findings, as set out in chapters 5 and 8 of the Background Document to the Guidelines for a Healthy Diet 2006[9], the Committee has concluded that there is no reason to revise these conclusions.

4.4.3 *Cancer*

The report Dietary Reference Intakes: Energy, Proteins, Fats and Digestible Carbohydrates concluded that it is unlikely that consumption of digestible carbohydrates has any influence on cancer risk. No new research findings have since been published to justify any other conclusion*.

4.4.4 *Dental caries*

The Council's 2001 report makes the point that consumption of digestible carbohydrates will inevitably result in some degree of acidity and the potential for dental damage.[3] Such problems are particularly likely to arise from consumption of easily fermentable monosaccharides and disaccharides. Whether this leads to caries depends on various person-specific factors and is influenced by the frequency with which the problematic carbohydrates are consumed and the individual level of dental hygiene.

* See chapters 5 and 8 of the *Background Document to the Guidelines for a Healthy Diet 2006.* [9]

Given a good fluoride supply, sensible dental hygiene and moderate carbohydrate intake frequency, the report suggested that the risk of additional caries was small. The report called for special attention to be given to the prevention of so-called baby-bottle caries: caries that develop as a result of young children frequently being given a feeding bottle of carbohydrate-containing drinks and thus having easily fermentable sugars in the mouth for long periods. According to the Committee, no new research findings have been published that necessitate revision of the earlier report's observations*.

4.5 Alimentary acids

Alimentary acids naturally present in the diet, such as citric acid, malic acid, lactic acid, tartaric acid and oxalic acid also contribute to energy intake, albeit to a very limited extent. Frequent and/or prolonged exposure of the teeth to such alimentary acids can lead to damage resulting from dental erosion. Similar problems can be caused by acids added to foods and particularly drinks during industrial production and preparation.

Dental erosion is the process by which the dental enamel and subsequently the soft underlying dental tissues are dissolved by acids present in the mouth. Unlike the process of dental caries, erosion is not localised but involves generalised attrition of the teeth. The seriousness of the damage depends on various factors, such as the residence time of the acids in the mouth, the way the individual drinks and the saliva secretion levels. A film of saliva around the teeth can serve as a sort of barrier against the acid and thus inhibit dental erosion. The presence of tartar and dental plaque can also reduce the risk of dental erosion. Dental erosion is most common among people whose oral hygiene standards are good. To keep the teeth in good condition, it is important to minimise exposure to alimentary acids.

4.6 Alcohol

The *Guidelines for a Healthy Diet 1986* indicated that epidemiological research suggested that moderate alcohol consumption reduced the risk of cardiovascular diseases, but that there were insufficient data available to justify recommending alcohol consumption on nutritional grounds.

* See chapter 6 of the *Background Document to the Guidelines for a Healthy Diet 2006*. [9]

The research findings published since 2001 lead the Committee to draw the following conclusions:*

Observational epidemiological research has provided strong, consistent evidence that moderate alcohol consumption by older men and postmenopausal women – but not by young people – probably reduces mortality risk. This effect is attributable largely to lower rates of mortality from cardiovascular diseases among moderate drinkers. The greatest protection is apparently afforded by consuming 10 to 20 grams of alcohol a day. The observed association has a plausible biological explanation, namely that alcohol consumption raises the HDL serum cholesterol level.

For an adult, the above-mentioned level of alcohol consumption will not generally entail any health risk. However, the possibility of slightly increased breast cancer risk cannot be excluded among women, particularly those whose family history features breast cancer**.[34] In view of the nature of the association between alcohol consumption and mortality risk, the maximum advisable level of alcohol intake may be put at 20 grams a day for adult men and 10 grams a day for adult women***. To secure a mortality risk benefit without introducing health risks, it is important that alcohol is consumed according to a regular pattern without consumption peaks.

The Committee would point out that starting to drink alcohol inevitably entails an element of risk, since a percentage of those who start to drink are liable to be drawn into excessive consumption. The Committee does not therefore consider it responsible to advise non-drinkers in general, or even those at increased risk of cardiovascular diseases, to start moderate alcohol consumption with a view to reducing the likelihood of developing cardiovascular diseases. Non-drinkers are better advised to seek to reduce their mortality risk by making other lifestyle changes, such as giving up smoking, taking more physical activity and adopting a healthier diet.

Young people up to the age of 18 should be advised against drinking, even in quantities that would be acceptable for adults, partly because of the risk of developing unhealthy drinking habits and partly because of the increased mortality risk associated with alcohol consumption in this age group.

Finally, the Committee endorses the conclusion contained in the report *Risks of Alcohol Consumption related to Conception, Pregnancy and Breastfeeding.*[8] In view of the associated health risks for foetuses and infants, women who are

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* See chapter 9 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

** See *Background Document to the Guidelines for a Healthy Diet 2006* subchapter 9.1.7.[9]

*** In the Health Council report *Ethanol (ethyl alcohol)* (No 2006/06OSH), the relationship between alcohol and breast cancer is examined from another policy perspective.

seeking to become or are liable to become pregnant, or who are breastfeeding are advised not to drink alcohol.

4.7 Dietary fibre

The recent report *Guideline for Dietary Fibre Intake* examined the appropriateness for the Dutch population[4] of the US Institute of Medicine's recommendation that a healthy diet should contain 3.4 grams of fibre per MJ[58]. The following conclusions were reached:

Dietary fibre expedites the passage of food along the digestive tract and can therefore reduce the risk of obstipation. For an adult, the ideal amount of fibre in a mixed diet is about 30 to 45 grams a day, assuming adequate fluid intake and physical activity.

A high-fibre diet diminishes the risk of coronary heart disease. Research has shown the lowest risk to be associated with a concentration of 3.1 to 3.5 grams of fibre per megajoule per day. There is reason to believe that dietary fibre from whole-grain cereal products and fruit is particularly effective in reducing the risk of coronary heart disease.

There are also strong indications that high consumption of many whole-grain cereal products can reduce the risk of type 2 diabetes mellitus. By contrast, an association between total dietary fibre intake and the risk of type 2 diabetes mellitus has yet to be convincingly demonstrated.

Observational epidemiological research has shown that a very low level of dietary fibre intake (the lowest quintile of intake) is associated with increased risk of colon cancer. However, it is unclear whether and, if so, to what extent, increasing dietary fibre influences the risk of colon cancer. The committee that developed the dietary fibre guideline concluded that the possible protective general effect of fibre against colon cancer remained unproven.

In line with these conclusions, the report makes a quantitative recommendation regarding dietary fibre intake, based on the effect of dietary fibre on intestinal function and the risk of coronary heart disease. Although some degree of uncertainty remains regarding the ideal level of dietary fibre intake, the report concludes that the level advised by the Institute of Medicine (3.4 grams per megajoule per day) is valid in relation to the adult Dutch population. This figure assumes a mixed diet made up of foods that are not enriched with isolated and purified fibre.

It is recommended that, during childhood, dietary fibre consumption be gradually increased with age*.

4.8 Fluids

The *Guidelines for a Healthy Diet 1986* contain no specific advice on fluid intake.[1] The point is made that, under normal circumstances, lack of fluid is not liable to occur in the Netherlands. According to the report, commonly consumed high-moisture-content foods (vegetables, potatoes, fruit) and drinks provide ample fluid under normal circumstances. The Committee has considered whether there is reason to revise this advice.

Having reviewed current scientific knowledge on this topic, the Committee has concluded that it is not possible to make a generally valid recommendation concerning fluid intake**. An individual's fluid requirements are strongly dependent on a variety of factors, including environmental conditions (temperature, humidity, etc), activity levels and the need to expel electrolytes via the kidneys. The available results indicate that, under normal circumstances, thirst – and consequent fluid intake via foods and drinks – is an adequate regulator of the bodily fluid balance until late in life. As a result, the fluid intake of a healthy person is not liable to fall below the required level under normal circumstances. However, it is important to make sure that people whose ability to care for themselves is impaired (some older people and (small) children who are unwell) do obtain sufficient fluid. Similarly, fluid intake requires special attention where older people with urinary incontinence are concerned. Advice covering such situations is given in chapter 11 of the *Background Document to the Guidelines for a Healthy Diet 2006*.[9]

4.9 Essential micronutrients

The Health Council has formulated dietary reference intakes for the vitamins thiamine, riboflavin, niacin, pantothenic acid, biotin, vitamin B_6, folic acid, vitamin B_{12} and vitamin D, as well as for the mineral calcium.[2,104] Only where calcium and vitamin D were concerned was account taken of an association between consumption and chronic disease risk.

* 1 to 3 years: 2.8 g per MJ; 4 to 8 years: 3.0 g per MJ; 9 to 13 years: 3.2 g per MJ; 14 to 18 years, increasing to 3.4 g per MJ.

** See chapter 11 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

Where the other specified essential micronutrients are concerned, either no association with the risk of chronic disease is believed to exist (thiamine, niacin, pantothenic acid and biotin) or the evidence for such an association is too weak for its existence to be assumed (folic acid, riboflavin, vitamin B_6 and vitamin B_{12}).

4.9.1 *Calcium*

The dietary reference intake for calcium is focused primarily on the prevention of osteoporosis. Where children and adults up to the age of 30 are concerned, intake is considered adequate when the point is reached where (further) increase would not result in increased bone mass. Where people over the age of 30 are concerned, calcium intake is considered adequate when the point is reached where further increase would have no influence on the speed of bone mass loss or on the fracture risk.[2] On this basis, an adult requires 1000 to 1100 milligrams of calcium a day.

According to the report *Dietary Reference Intakes: Calcium, Vitamin D, Thiamine, Riboflavin, Niacin, Pantothenic Acid and Biotin*, it is probable that the dietary reference intake of calcium will help to prevent high blood pressure and may possibly also help to prevent colon cancer. Recently published data from the US Women's Health Initiative Study indicate that, in postmenopausal women, daily consumption of a supplement containing 1 gram of calcium carbonate and 10 micrograms of vitamin D_3 has no effect on the risk of colorectal cancer after seven years.[105] Considering the age of the women (an average of 62 at the start of the study), the length of the intervention period, the uncertainty that exists concerning the degree of compliance, the level of calcium intake in the control group and the long latency period of colorectal cancer (10 to 20 years), it is very doubtful that an observable effect could reasonably have been expected.[106,107] The Committee accordingly takes the view that the results of this study do not warrant revision of the Council's earlier conclusion regarding the association between calcium intake and the risk of colon cancer.

4.9.2 *Vitamin D*

Where vitamin D is concerned, there is good reason to believe that increasing intake to a level above that necessary to prevent osteomalacy and rachitis contributes to the formation and maintenance of a strong skeleton and thus to the prevention of fractures. An adequate intake is defined as the level at which further increase would not reduce the risk of a fracture. This level has been esti-

mated on the basis of the association between vitamin D intake, blood calcidiol level, bone density and fracture risk.

There is no international consensus concerning the blood calcidiol level corresponding to an ideal vitamin D level. Recommendations range from 30 to 75 nanomoles per litre. The 2000 report *Dietary Reference Intakes: Calcium, Vitamin D, Thiamine, Riboflavin, Niacin, Pantothenic Acid and Biotin* stated that there was insufficient evidence on which to base vitamin D targets in excess of 30 nanomoles of calcidiol per litre of serum. The attainment of higher levels by increasing vitamin D intake would not influence bone density or fracture risk. In the USA, Canada and France, a threshold value of between 75 and 80 nanomoles per litre is currently applied. Various Dutch authors have argued that the threshold value of 30 nanomoles per litre cited in the Health Council report should be increased to at least 50 nanomoles per litre.[108-110]

According to *Dietary Reference Intakes: Calcium, Vitamin D, Thiamine, Riboflavin, Niacin, Pantothenic Acid and Biotin*, it seemed probable from the research data available at that time that consumption of at least 10 micrograms a day of vitamin D reduced fracture risk for people aged 70 and above. People in this age group were accordingly advised to aim for a daily intake of 15 micrograms if they were not exposed to sufficient sunlight and 12.5 micrograms if their exposure was sufficient. Since the report's appearance, additional research findings have been published, which shed further light on the association between fracture risk and vitamin D intake.

A meta-analysis of seven randomised controlled clinical studies was unable to discern any reduction in the incidence of bone fractures among subjects receiving vitamin D suppletion to the level recommended by the report.[111] It did appear, however, that higher doses had a protective effect. On the basis of their analytical findings, the researchers suggested that there was a strong case for providing older people with vitamin D suppletion of 17.5 to 20 micrograms a day.

The US Women's Health Initiative Intervention Study found that, after a seven-year follow-up, little or no effect on bone density or hip fracture risk could be observed in women who had received a daily supplement of 1 gram of calcium carbonate and 10 micrograms of vitamin D_3.[112] However, this finding is probably attributable in part to the low compliance of the subjects and the fact that many women in the control group were themselves consuming calcium or vitamin D in therapeutic quantities. Among subjects who did comply with the suppletion regime, there was a significant effect on the bone density and hip fracture risk.

A three-year randomised study of older people living independently found that daily suppletion with 500 milligrams of calcium citrate and 15.7 micrograms of vitamin D considerably reduced the fall risk – and therefore the hip fracture risk

– among women. The effect was most apparent among women who undertook relatively little physical activity.[113]

The recent findings suggest that a vitamin D intake of 10 micrograms a day – the figure used as the basis for calculating the dietary reference intake for older people in 2000 – is probably on the low side and does not afford optimal protection against (hip) fracture. The Committee accordingly recommends that this matter be addressed in the context of the report on essential micronutrients currently being prepared by the Health Council.

4.9.3 *Folic acid*

The dietary reference intake for folic acid was defined on the basis of the observation that dietary suppletion with 400 micrograms of folic acid around the time of conception was effective in protecting against the development of neural tube defects. The evidence that folic acid might also protect against spontaneous abortion, Down's syndrome and congenital abnormalities such as hare lip, cleft pallet, hip abnormalities, heart abnormalities and abnormalities of the urinary tract were not considered sufficiently consistent to be taken into account when setting the dietary reference intake. The epidemiological research observation that folic acid might inhibit the development of various forms of cancer, in particular colon cancer, was similarly excluded from consideration.

With regard to the significance of folic acid for the risk of cardiovascular diseases, the report *Dietary Reference Intakes: Vitamin B_6, Folic Acid and Vitamin B_{12}* stated that, pending the results of ongoing clinical intervention studies, no account of the possible influence of folic acid on plasma homocysteine levels had been taken when calculating of the dietary reference intake of this substance. The evidence suggesting that plasma homocysteine concentration could legitimately be regarded as a risk factor for cardiovascular diseases was at that time too inconsistent to support a definitive conclusion. Since the report's publication, the results of various clinical interventional studies have been made available (VISP, HOPE-2 and NORVIT).[114-116] None of these studies has been able to confirm that folic acid suppletion influences the rate of mortality resulting from cardiovascular diseases*. The Committee therefore sees no reason to revise the present dietary reference intake for folic acid to prevent cardiovascular diseases.

* The results of the intervention study conducted by the Wageningen Center for Food Sciences are not yet available. Although these results were originally expected in 2005, the study has been extended because the incidence of cardiovascular diseases within the research population was too low to draw any conclusion regarding the effect of folic acid.

Although in recent years more data have become available suggesting that folic acid (suppletion) can reduce the risk of Alzheimer's disease and prevent accelerated loss of cognitive function[117-119], the findings are not decisive. A recent Dutch study – the Leiden 85-Plus Study – did establish an association between folic acid status and reduced cognitive function, but poor folic acid status did not appear to be a predictor of accelerated cognitive function loss.[120] Indeed, a prospective cohort study of older people found after a six-year follow-up that people in the group with a high folic acid intake exhibited twice the deterioration in cognitive function observed in the group with the lowest folic acid intake.[121] A recent randomised controlled intervention trial of older people was unable to observe any improvement in cognitive function associated with folic acid suppletion (1 milligram per day) over a two-year period.[122]

The Committee takes the view that data from randomised controlled intervention studies are presently too sparse and too inconsistent to support any conclusion regarding the significance of folic acid for cognitive function or the risk of developing Alzheimer's disease.

4.9.4 *Riboflavin, vitamin B_6 and vitamin B_{12}*

When compiling its earlier report, the Dietary Reference Intakes Committee concluded that the evidence suggesting that riboflavin might protect against the development of conditions such as cancer of the oesophagus and glaucoma was too meagre to be taken into account when defining a dietary reference intake for this micronutrient.[2] A similar conclusion was drawn with regard to the suggestion that low vitamin B_6 or vitamin B_{12} intake could increase the risk of cardiovascular diseases.[104] The present Committee sees no reason to revise these conclusions.

On the basis of a recent systematic review of available data, Malouf concluded that the evidence for an association between vitamin B_{12} status and loss of cognitive function in older people was too sparse and not sufficiently convincing to support any conclusion.[123] The Committee endorses this view.

Chapter 5

Foods and dietary patterns

In this chapter, the contribution that a number of foods can make to a healthy diet is considered. Because in practice foods are always eaten in combination, the effect of certain dietary patterns on the risk of chronic diseases is also addressed.

5.1 Specific high-cholesterol foods

As indicated earlier in this report, the Committee does not consider it necessary to give quantitative advice on dietary cholesterol intake, since a diet that is consistent with the advice on saturated fat will inevitably contain relatively little cholesterol. Nevertheless, above-average consumption of certain high-cholesterol foods, such as eggs, crustaceans and shellfish, as well as certain types of offal, is discouraged*.

Few epidemiologic studies have sought to establish the effect of egg consumption on serum cholesterol levels, and those that have done so have often had methodological shortcomings. Furthermore, the results obtained have been inconclusive. Neither the *Nurses Health Study* nor the *Health Professionals Follow-up Study* found that eating an egg a day was significantly associated with the risk of coronary heart disease.[124] On the basis of a review which analysed the data from various observational studies, Kritchevsky concluded that the consumption of eggs was not associated with raised serum cholesterol levels.[125] He accordingly

* See chapter 4 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

concluded that there was no adequate scientific basis for discouraging the consumption of eggs on the grounds that they tended to adversely affect serum cholesterol levels.

However, it seems from a meta-analysis of the results of properly controlled studies that eating eggs does increase the ratio between total serum cholesterol and HDL cholesterol.[126] The addition of 100 milligrams of cholesterol to the diet increases this ratio by 0.020 units, and the consumption of an extra egg pushes up the ratio by 0.040 units*. It appears that egg consumption puts up LDL serum cholesterol more than HDL cholesterol. This has a negative influence on the blood lipoprotein profile, thus increasing the risk of coronary heart disease. Although the estimated increase in risk is relatively small at the individual level**, the population-level implications can be substantial according to Weggemans et al. These researchers therefore contend that the advice to restrict consumption of relatively high-cholesterol products – including eggs – remains reasonable. The Committee shares this view.

5.2 Added sugars

The addition of sugar(s) to foods and drinks increases energy density and reduces nutrient density. In the context of this report, the term 'added sugar' covers saccharose, glucose and fructose added to foods or drinks either during industrial production or by the consumer.

5.2.1 Added sugars and energy balance

As indicated in subchapter 3.1.3, some expert committees in other countries discourage the consumption of added sugars with a view to prevent weight gain. In most cases, it is advised that added sugars should account for no more than 10 per cent of overall energy intake***. However, the Committee takes the view that the scientific evidence regarding this association is insufficient to justify a ceiling value of this kind****.

Provided that the consumption of (products with) added sugars does not lead to a positive energy balance, such sugars should not compromise weight regulation any more than more than other energy-providing nutrients. Although the evidence is limited, the results of prospective epidemiological research do suggest

* According to the NEVO table, a 50 grams egg contains about 116 milligrams of cholesterol.
** The authors estimate this increase to be 2.1%.
*** See subsection 5.2 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]
**** See chapter 5 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

that higher levels of added sugar in the diet are associated with higher overall energy intake. It has yet to be demonstrated, however, that added sugar intake is also associated with undesirably high bodyweight. Nevertheless, the Committee thinks that restricting the consumption of (products with) added sugars may well help someone with a positive energy balance to attain a neutral balance. Such an individual is therefore well advised to limit the amount of added sugars in his/her diet as much as possible, and certainly to less than his/her discretionary energy intake. Estimated discretionary energy intake levels for various age groups are presented in subchapter 5.4.5 of the *Background Document to the Guidelines for a Healthy Diet 2006*; theoretically, the amounts of energy in question could be obtained exclusively from added sugars. On the basis of current average activity patterns, adult men aged 19 to 50 have discretion over a maximum of 750 kilocalories of intake a day, while the corresponding figure for adult women is 600 kilocalories. For children and older people, discretionary energy intake is lower, while for adolescents it is higher. It must be understood, however, that the figures are theoretical maxima, since in practice other items will be eaten in addition to the staple foods, which also contribute to the overall energy value of the diet. Hence, the practical scope for obtaining discretionary energy from added sugars will be somewhat less.

5.2.2 *Added sugars and the supply of essential micronutrients*

A higher level of added sugar in the diet generally goes hand-in-hand with a lower dietary nutrient density*. However, a wide range of added sugar intake levels may apparently be consistent with an adequate supply of essential micronutrients.

Opinion differs as to the dietary significance of reduced nutrient density. The reduction in supply observed by researchers differs markedly from nutrient to nutrient and is generally modest in comparison with average intake. It appears more likely that high dietary intakes of added sugar are an aggravating factor than a cause of a low level of supply. Furthermore, problems can arise if foods with a low nutrient density are substituted for foods with a high nutrient density.

If a person's energy intake is low, the essential micronutrient supply is particularly vulnerable to disturbance associated with a higher level of added sugar in the diet. However, the available research data do not provide any clear criteria for recommending a ceiling on the amount of added sugar in the diet with a view to securing the micronutrient supply. In the Netherlands, an added sugar intake that

* See chapter 5 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

accounts for more than 20 per cent of total energy intake appears to be associated with disturbance to the supply of essential micronutrients. The extent to which the nutrient supply is disturbed varies from nutrient to nutrient. The available data are inconclusive, however, with regard to the amount of added sugar there needs to be in the diet before the adequacy of the nutrient supply is seriously threatened.[127]

The scope for obtaining discretionary energy from added sugars, as referred to in subchapter 5.2.1, is such that the supply of protein, essential micronutrients and dietary fibre is not threatened by added sugar intake. It is mainly in cases where a person's energy requirements are relatively low (as with children up to the age of nine and older people) or where a person has a low-energy diet (< 8 megajoules) that it is advisable to limit added sugar consumption in order to ensure that supplies of essential micronutrients and dietary fibre are not threatened.

5.3 Sugar containing drinks

In the context of energy balance maintenance, it is apparently important whether sugar is ingested in solid foods or in drinks. According to the 2003 report *Overweight and Obesity*, the evidence then available suggested that the consumption of soft drinks easily led to a positive energy balance without the person having any sense of overeating.[7] The additional energy provided by soft drinks does not usually replace energy from another source; compensation mechanisms appear to be less effective where such drinks are concerned. The evidence for this effect has become stronger since 2003*.

Although the scientific evidence is decisive, the Committee considers it likely that energy from soft drinks does not induce a sense of saturation to the same degree as energy from sugars in solid foods. As a result, soft drinks probably facilitate the passive over-consumption of energy and the development of a positive energy balance. Hence, reducing the consumption of such drinks can help to curb weight gain and achieve weight loss. The Committee does not believe that there is sufficient evidence to conclude that sugars naturally present in fruit juices stimulate the saturation mechanism in a different way from drinks containing added sugars. It is not known to what extent other components in fruit juices (e.g. dietary fibre) influence the sense of saturation.

* See subchapter 5.3.2 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

5.4 Foods and drinks containing easily fermentable carbohydrates

With a view to preventing caries, the *Guidelines for a Healthy Diet 1986* recommended restricting the consumption of foods and drinks containing easily fermentable carbohydrates (monosaccharides and disaccharides) between meals. The scientific evidence in favour of such restriction remains convincing*. The Committee believes that the frequency with which such foods and drinks are consumed should be sufficiently low to allow for remineralisation of the dental enamel following each acidic assault. This is believed to equate to a consumption frequency not exceeding four times a day, excluding the three main meals.

5.5 Drinks and foods with a high concentration of alimentary acids

Acidic fruit juices – particularly grapefruit, lemon, lime and orange juices, as well as drinks containing these juices – contain large amounts of fruit acid, which can lead to dental erosion**. The same is true of (carbonated) soft drinks to which, for example, citric acid, malic acid, tartaric acid, ascorbic acid or phosphoric acid has been added. Also, ice-tea is potentially highly erosive, in contrast to aromatic fruit tea. However, it is not easy to rank alimentary acids or drinks according to their potential for causing damage. Whether a drink does or does not contain easily fermentable carbohydrates has no influence on the development of dental erosion.

Unlike fruit juices and soft drinks, milk and milk products inhibit dental erosion. The high calcium and phosphate concentrations of these products counteract the dissolution of these minerals in the enamel. Furthermore, high calcium and phosphate concentrations in the saliva facilitate the remineralisation process.

Various studies have also observed a positive association between the consumption of fruit – particularly citrus fruit – and the level of dental erosion. However, since fruit-eating generally stimulates salivation, thus increasing the anti-corrosive buffer in the mouth, the Committee feels it is reasonable to suppose that eating fruit does not increase the risk of dental erosion to the same extent as drinking fruit juice.

In principle, the maximum consumption frequency of easily fermentable carbohydrate-containing foods and drinks recommended in the context of dental caries prevention is also valid in the context of dental erosion prevention. It is

* See chapters 5 and 6 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]
** See chapter 6 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

particularly important that the frequency and duration of exposure to acids from foods and from drinks in particular does not exceed the buffering capacity of the saliva.

5.6 (Mineral) water

In 1994, a campaign was launched in the USA to encourage people to drink at least eight glasses of (mineral) water a day (roughly 1.9 litres), in addition to their other food and drink, with a view to promoting health and wellbeing. The assertion was that this level of (mineral) water consumption would reduce the risk of conditions such as bladder cancer, colorectal cancer, coronary heart disease, urinary tract infections, kidney stones and chronic obstipation. Drinking water in the recommended quantities was apparently also good for the complexion, vitality and weight loss. Following an extensive literature study, Valtin came to the conclusion that there was no physiological or scientific basis for the recommendation.[128] In their fluid intake advice, the US Institute of Medicine and the Nordic Council of Ministers also highlight the absence of adequate scientific evidence for the suggested effects*.

Only for people who have a low-energy diet or who lack appetite it is perhaps advisable to ensure extra fluid intake in the form of drinks, to compensate for the small amount of moisture taken with solid foods and the reduced levels of oxidation water formation in the context of intermediate metabolism. However, even these people should ordinarily be able to rely on their thirst as a reliable indicator of their fluid requirements.

5.7 Alcoholic drinks

On the basis of the data summarised in chapter 9 of the *Background Document to the Guidelines for a Healthy Diet 2006*[9], adult men who are in the habit of drinking alcohol are advised to limit consumption to two Dutch standard units a day, while adult women should restrict themselves to one standard unit a day. Such moderate drinking will not normally entail any health risk, but can reduce the likelihood of mortality from cardiovascular diseases. It is important to understand that what is advised is regular moderate consumption; the figures cited are not recommended averages for a period of several days. Moderate daily alcohol consumption without peaks can be part of a healthy adult lifestyle. However, the scientific data currently available are not regarded by the Committee as suffi-

* See chapter 6 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

ciently consistent to support a conclusion regarding the significance for the risk of mortality from cardiovascular diseases of the type of alcoholic drink or whether alcohol is consumed during meals.

5.8 Fish

As indicated in subchapter 4.2.1, the Committee believes that, to prevent cardiovascular diseases, the dietary reference intake of n-3 fatty acids from fish should be increased from the 200 milligrams a day recommended by the Health Council in 2001 to 450 milligrams. In the light of recent research results, it now appears probable that regular consumption of fish reduces the risk of mortality from cardiovascular diseases*. It is difficult, however, to specify an ideal level of fish consumption on the basis of the available data. There is good reason to believe that the association between fish consumption and the risk of mortality from cardiovascular diseases is not linear. The greatest protective effect is achieved by switching from non-consumption or very occasional consumption of fish to the consumption of at least one portion of fish a week.

In subchapter 3.5.1, the *Background Document to the Guidelines for a Healthy Diet 2006* state that, to achieve the dietary reference intake of 450 milligrams of n-3 fatty acids from fish a day, it is necessary to eat two portions of fish a week, at least one of them being oily fish (such as salmon, herring or mackerel).[9] At present, the average Dutch person gets most of his/her fish oil fatty acid by eating appropriate types of fish as part of a cold lunch. The Committee accordingly recommends that people seek to go over to eating fish once a week as part of the main meal of the day, and once a week as part of a cold lunch. When translating this recommendation into practical dietary advice, allowance should be made for the possible toxicological risks from methyl mercury, which the consumption of certain types of fish regarded as exotic in the Netherlands (such as shark, swordfish and marlin) can entail for unborn and young children.

It is likely that the protective effect of fish consumption is attributable to n-3 fatty acids. Although some fish oil-enriched foods are available on the market, the Committee considers it preferable to eat actual fish, since it is not yet certain that eating enriched products has the same effect on cardiovascular disease risk as eating fish. Nevertheless, the consumption of fish oil fatty acid-enriched foods may be an acceptable alternative for people who do not eat fish. In view of the risk of overdosing, the Committee expressly advises against relying on fish oil preparations as one's source of n-3 fatty acids from fish.

* See chapter 3 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

5.9 Fruit and vegetables

5.9.1 Cardiovascular diseases and cancer

There is good reason to suppose that there is an inverse association between fruit and vegetable consumption and the risk of cardiovascular diseases and certain types of cancer (cancer of the oesophagus and stomach)*. However, the epidemiological evidence for such an association has actually become weaker over time. This is partly due to study design: more recent studies have generally been methodologically superior to earlier studies. Nevertheless, it remains difficult to obtain a proper stament of fruit and vegetable consumption by means of the food frequency method used in observational research.

Noting that the inverse association remains, regardless of study quality, the Committee concludes that ample consumption of fruit and vegetables probably does reduce the risk of cardiovascular diseases and certain types of cancer. However, without evidence of this association from randomised controlled studies, it is not possible to say that such an association has been convincingly demonstrated.

From the data currently available, it is not possible to specify what constitutes an ideal fruit and vegetable intake in quantitative terms. Nevertheless, the Committee considers it likely that, for an adult, the ideal is around 150 to 200 grams of vegetables and a further 200 grams of fruit a day. Eating the stated amounts of fruit and vegetables will at least make an adequate contribution to the supply of vitamins, minerals and dietary fibre.

The Committee does not believe that the available research data indicate clearly whether and, if so, to what extent fruit and vegetables are interchangeable in the context of securing protection against the risk of cardiovascular diseases and cancer. Nor is it apparent whether, in this context, preference should be given to particular types of fruit and vegetable. Because the mechanism responsible for the protective effect remains uncertain, it is advisable to eat a variety of fruit and vegetables.

The Committee is similarly unable to make any definitive statement as to whether and, if so, to what extent the degree to which fruit and vegetables have been processed (pressed, purified, pasteurised, sterilised, etc) influences their protective properties. The reason being that none of the studies underpinning the analyses considered the degree of processing. Nevertheless, the Committee considers it likely that the less the original structure and composition has been

* See chapter 7 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

affected by processing, the more akin a processed product will be to the fruit or vegetable from which it is made.

Epidemiological research into the association between fruit and vegetable consumption and the risk of chronic diseases has tended to focus on intake of solid fruit and vegetables, rather than juices obtained from them. Consequently, one cannot simply assume that fruit and vegetables juices have the same protective effect as the source produce. Juice consumption should therefore be seen as a supplement to fruit and vegetable consumption, rather than an alternative*. Again, variety would appear to be important.

5.9.2 Other chronic diseases

The ability of fruit or vegetables to protect against other chronic diseases is unproven in the Committee's view**. However, it would appear probable from the available research data that a diet rich in fruit and vegetables that have a low energy density contributes to energy balance maintenance***. The Committee considers it likely that fruit and vegetable juices are not equivalent to solid fruit and vegetables in this context, since liquids appear to have a different effect on the saturation mechanism.

5.10 Salt (sodium)

Conclusions of earlier Health Council reports

To prevent high blood pressure and reducing the risk of cardiovascular diseases, the *Guidelines for a Healthy Diet 1986* recommended limiting personal consumption of salt – by far the largest source of dietary sodium – to what was then the national average consumption level****.[1] In line with this recommendation, the slogan 'Go easy on the salt!' was adopted for public information purposes.

In 2000, the Health Council published its report *Salt and Blood Pressure*, which stated that if people in the Netherlands could be persuaded to cut their salt consumption, average systolic – and possibly diastolic – blood pressure could be reduced and the prevalence of high blood pressure thus diminished.[5] The report did nevertheless make the point that the benefit for people whose blood pressure

* Fruit juices also bring a greater risk of dental erosion than solid fruit. See chapter 6 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

** See chapter 7 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

*** See also the conclusion of the report *Overweight and Obesity.*[7]

**** At that time nine grams of salt a day, which equates to roughly 3.6 grams of sodium.

was normal would be slight. Each one-gram cut in sodium intake (2.5 gram cut in salt intake) could be expected to bring down systolic blood pressure by 1 millimetre of mercury (mmHg) in a normotensive person and by 2.5 mmHg in a hypertensive person. The corresponding reduction in diastolic blood pressure would be up to 0.7 mmHg for a normotensive person and 1.8 mmHg for a hypertensive person. It has been estimated that a 1mmHg reduction in systolic blood pressure would cut mortality from coronary heart disease by between 1.5 and 3 per cent.

The report pointed out that little research had been conducted into the association between sodium intake and mortality from coronary heart disease and that the available findings were inconsistent. The report itself contained no recommendations regarding practical intervention with a view to reducing salt consumption in the Netherlands. Its authors declined to make any such recommendations on the grounds that reducing national sodium intake would be a major undertaking, whose potential benefits in terms of reduced blood pressure would be modest. Furthermore, doubt was expressed as to whether a substantial and lasting population-level reduction in sodium intake could be achieved by intervention and publicity campaigns. A reduction in the amount of sodium in commercially prepared foods would certainly be necessary. Hence, progress could not be made without the cooperation of food manufacturers, catering firms and other food outlets. The letter accompanying the report did, however, recommend keeping the 'Go easy on the salt!' message, preferably as part of a multitrack approach, whose other elements should include promoting fruit and vegetable consumption and physical activity, and acting to discourage overweight and excessive alcohol consumption.

Recent research data

The report *Salt and Blood Pressure* takes account of literature published up to the summer of 2000. Relevant studies published since then are listed in subchapter 10.3 of the *Background Document to the Guidelines for a Healthy Diet 2006*.[9] The main findings are also summarised below.

On the basis of a new meta-analysis, He and MacGregor estimate that, at the population level, a moderate reduction in sodium intake would have a significant effect on the blood pressure of both hypertensive and normotensive people.[129] These authors suggest that the systolic blood pressure reduction attainable by a 1-gram cut in sodium intake (2.5-gram cut in salt intake) would be a little higher than indicated in the report *Salt and Blood Pressure* (3.1 mmHg versus 2.5 for hypertensives, and 1.6 mmHg versus 1.0 for normotensives). With regard to the

likely effect on diastolic blood pressure, He and MacGregor concur with the figures cited in the report *Salt and Blood Pressure.*

From the available research findings – including those of randomised controlled interventional studies such as the US DASH studies[*,130-132] – it is clear that there is a progressive dose-response relationship between sodium intake and blood pressure, without a clear threshold value. This implies that sodium intake should in principle be limited as far as possible.

The European Food Safety Authority recently concluded that the available research data were not sufficient to support a safe upper sodium intake level.[133] Most expert committees in other countries currently recommend limiting salt intake to 6 grams a day, while emphasising that this figure should not be seen as an ideal or acceptable level, but as a realisable target for dietary salt consumption. Cutting salt intake to below this level would be more beneficial in health terms.

New research findings

The Committee takes the view that the limitation of salt consumption to 6 grams a day would be a reasonable objective for the Netherlands as well. The impact of such a change on national average blood pressures would depend on the actual level of sodium intake prior to implementation: the higher the starting level, the greater the impact of the reduction. However, as indicated in subchapter 2.2, little is known about current sodium intakes in the Netherlands. The most recent – but very sparse – data relate to the period 1995 to 1997 and put average adult sodium intake at 3.9 grams a day.[18] This equates to roughly 9.8 grams of salt. Given that commercially prepared foods and ready-to-eat meals have become more widely available in the last 10 years, the Committee considers that current average intake levels are unlikely to be lower than those referred to above.

Finally, the Committee would draw attention to the work of Geleijnse et al, who emphasise that the influence of diet and lifestyle on the prevalence of high blood pressure in the population is dependent not only on the strength of the association between the risk factors and blood pressure, but also on the prevalence of the various risk factors within the population.[134] The relevant risk factors include overweight, excessive salt consumption, lack of physical activity and inadequate potassium intake. The Committee accordingly believes that advice to limit salt consumption with a view to reducing the risk of high blood pressure should not be given in isolation, but in combination with advice on

* DASH = Dietary Approaches to Stop Hypertension.

making other lifestyle changes, including losing weight, getting more physical activity, following a diet rich in fruit, vegetables, low-fat dairy products and whole-grain cereal products and low in saturated and mono-trans-unsaturated fatty acids and alcohol*. Thus, the Committee effectively endorses the conclusion of the 2000 report *Salt and Blood Pressure.*

5.11 Dietary patterns

It is increasingly clear that the way foods and drinks are combined on a daily basis has a specific effect on the nutrient supply and on the risk of chronic diseases. What matters appears to be the presence and/or absence of certain dietary constituents in combination, coupled with the interactions between certain dietary constituents. There are strong signs that certain dietary patterns reduce the risk of chronic diseases, while others increase the risk. In recent years, therefore, epidemiological research has increasingly investigated associations between certain dietary patterns and the risk of chronic diseases.

5.11.1 Drawbacks of a traditional western dietary pattern

A prospective cohort study has found that the traditional western dietary pattern (including a lot of red meat, refined products, full-cream milk and dairy produce and snacks) brings a higher risk of overweight,[136] type 2 diabetes mellitus [137] and coronary heart disease[138] than a dietary pattern based on a lot of whole-grain cereal products, vegetables, fruit and fish. The Dutch MORGEN project illustrated the health benefit of a dietary pattern characterised by relative high consumption of vegetable oils, garlic, stir-fried vegetables, salads, pasta, poultry, fish and wine and relative low consumption of potatoes. This dietary pattern was associated with lower blood pressure and higher HDL serum cholesterol level than a traditional Dutch diet, featuring a lot of red meat, potatoes and saturated fats in the form of spreads and cooking fat.[139]

US authors often emphasise that, in intervention studies, the aforementioned DASH diet has been found to have a favourable influence on the risk profile for cardiovascular diseases (blood pressure and blood lipoproteins).[103,130,131,140-142] The DASH diet, in which emphasis is given to the consumption of fruit, vegetables, nuts and low-fat dairy products, is rich in carbohydrates (58 per cent of

* The so-called DASH diet. For details, see for example Lin et al.[135] and chapter 10 of the *Background Document to the Guidelines for a Healthy Diet 2006.*[9]

energy intake) and has relatively little total fat (27 per cent of energy intake), saturated fatty acid (6 per cent of energy intake), cholesterol and salt.

A diet of this kind is recommended by the US Dietary Guidelines Advisory Committee 2005 for the prevention of diet-related chronic diseases.[21] Such a diet is also known to have a positive effect on bone metabolism.[135]

5.11.2 *Benefits of a Mediterranean dietary pattern*

Many authors have indicated that a Mediterranean diet affords better protection against chronic diseases, such as cardiovascular diseases and cancer, than a typical West-European diet. From the available data, however, it is not possible to identify with certainty any one feature of the Mediterranean diet that is responsible for this observation. In the literature, the phrase 'Mediterranean diet' is used to describe a dietary pattern such as that which prevailed in Greece in the 1950s and 60s. This is a diet rich in olive oil (the principal fat source), salad, vegetables, legumes, whole-grain cereal products, olives, grapes and other fruit. Other features of the diet are moderate wine consumption (with the meal), moderate to frequent fish consumption, and regular consumption of poultry and dairy products, the latter typically in the form of cheese and yogurt. The diet contains relatively little red meat or red-meat products and relatively little animal fat.[143,144] In most cases, this dietary pattern was traditionally combined with moderately strenuous to strenuous physical activity. The fat content of the Mediterranean diet can be high: total fat intake varies from about 30 per cent of energy intake in Italy to about 40 per cent of energy intake in Greece. In Greece, the diet is characterised by a high level of olive oil consumption, in Italy by a high level of pasta consumption and in Spain by a high level of fish consumption.

Various studies have indicated that, compared with the typical western dietary pattern, the traditional Mediterranean diet can reduce the risk of mortality from cardiovascular diseases and certain types of cancer.[145,146]

The results of the European *HALE Project* suggest that, up to an advanced age (70 to 90) the consumption of a Mediterranean diet* combined with moderate alcohol consumption, non-smoking and moderate to strenuous physical activity considerably diminishes the risk of mortality from coronary heart disease, cardiovascular diseases, cancer and other conditions.[147] Furthermore, the *EPIC-Elderly Study* has established that the more the diet conforms to the traditional Mediterranean pattern, the greater the life expectancy of Europeans over the age of 60.[148]

* Mediterranean diet score of at least 4 on the scale devised by Trichopoulou et al.[145]

The *Lyon Diet Heart Study* found that, among people with coronary heart disease, the consumption of a Mediterranean diet enriched with α-linolenic acid considerably reduced the risk of cardiovascular diseases and total mortality . The effect of this diet was not a product of its influence on total serum cholesterol, HDL cholesterol, LDL cholesterol, triacylglycerol or lipoprotein (a).[149]

The findings of the Spanish PRIMED Study have recently entered the public domain.[150] This randomised controlled multi-centre intervention study established that, after four years, a Mediterranean diet with supplementary olive oil and nuts had a more favourable effect on the risk factors for cardiovascular diseases than a low-fat diet. The risk factors monitored were plasma glucose level, systolic blood pressure and the ratio between total serum cholesterol and HDL cholesterol.

In light of the findings described above, the Committee shares the view expressed by various authors that, for the purpose of preventing diet-related chronic diseases, the overall dietary pattern warrants more attention than the consumption of individual foods or food components.

Chapter 6

Conclusion: guidelines and recommended dietary changes

As indicated in chapter 2, over recent decades the Dutch national diet has changed in various respects, some favourable and others unfavourable. The decreases in consumption of saturated fatty acids, mono-trans-unsaturated fatty acids and cholesterol and the possible slight increase in fish consumption may be regarded as positive developments. However, declining consumption of fruit and vegetables is undesirable. In the subsequent chapters, the Committee has described numerous relevant findings and discussed their evidential value. In this chapter, these findings are translated into dietary advice. The committee's basic dietary guidelines are set out in subchapter 6.1. In subchapter 6.2, these guidelines are considered in more detail and the dietary changes required in this context are identified.

6.1 Guidelines

As indicated in subchapter 1.4.3, the *Guidelines for a Healthy Diet* apply to the general population from the age of one year. In qualitative terms, for someone with a neutral energy balance (stable and healthy bodyweight; for adults, a BMI of 18.5 to 24.9 kg/m^2), the guidelines may be summarised as follows: Ensure a varied diet, rich in vegetables, fruit and whole-grain cereal products. Regularly eat fish and low-fat dairy and meat products. Limit consumption of products with a high concentration of saturated and mono-trans-unsaturated fatty acids, salt, foods and drinks with easily fermentable sugars and drinks with a high concentra-

tion of alimentary acids; do not drink too much alcohol. Combine this diet with adequate physical activity.

The qualitative guidelines have been translated into the following *quantitative* targets for *adults*:

- Take at least half an hour's moderately strenuous physical activity – brisk walking, cycling, gardening, etc – at least five days a week, but preferably every day.
- Eat 150 to 200 grams of vegetables and 200 grams of fruit a day.
- Eat 30 to 40 grams a day of dietary fibre, from sources such as fruit, vegetables and whole-grain cereal products.
- Eat two 100 to 150-gram portions of fish a week, at least one of which should be oily fish.
- Limit saturated fatty acid consumption to less than 10 per cent of energy intake and mono-trans-unsaturated-fatty acid consumption to 1 per cent of energy intake.
- Limit consumption of foods or drinks that contain easily fermentable sugars, or drinks that are high in alimentary acid, to 7 occasions a day (including main meals).
- Limit consumption of salt to less than 6 grams a day.
- If alcohol is consumed at all, male intake should be limited to two Dutch standard units a day and female intake to one unit.

Quantitative targets for other age groups can be extrapolated from the above. Alcohol consumption is inadvisable for the under-eighteens, and for pregnant women, women who are seeking or liable to become pregnant and women who are breastfeeding.

The following additional guidelines apply to people who are overweight or gaining weight undesirably:

- Take at least an hour's moderately strenuous physical activity – brisk walking, cycling, gardening, etc – a day (as opposed to the half hour recommended for others).
- Limit consumption of products with a high energy density, i.e. products that are high in saturated and mono-trans- unsaturated-fatty acids and added sugars ('empty calories').
- Limit consumption of added sugar containing drinks.
- Limit portion sizes.

6.2 Recommended changes

6.2.1 Energy balance

With a view to reducing the risk of various chronic diseases, it is important that the low present average level of activity is increased by encouraging more people to meet the Dutch Standard for Healthy Physical Activity. For adults, the standard is at least 30 minutes of moderately strenuous physical activity at least five days a week, but preferably every day. People whose energy balance is currently positive need to take more physical activity – at least one hour a day – in order to redress that balance.

Such people should also seek to reduce their consumption of foods with a high energy density as far as possible. The main 'problem' foods in this regard are those that are high in saturated and mono-trans-unsaturated-fatty acids and in added sugars (so-called 'empty calories'). People with a positive energy balance should seek to replace high energy-dense foods with foods that have high nutrient density and a high dietary fibre content. It is also advisable for these people to reduce their consumption of drinks containing added sugars, including sweetened tea and coffee.

6.2.2 Fatty acid composition of the diet

Further change is required in the fatty acid composition of the average diet, to bring it into line with the dietary reference intake and the advice on consumption of the various types of fatty acid. The average concentration of saturated fatty acids in the national diet needs to be cut, so that instead of accounting for 13 to 14 per cent of energy intake, such fatty acids account for less than 10 per cent. Similarly, mono-trans-unsaturated-fatty acid intake needs to be brought down from 1 to 2 per cent to less than 1 per cent. While defining these targets, the Committee wishes to emphasise that the recommendation is to minimise consumption of both types of fatty acids as far as possible. The reduction should preferably be achieved by substituting cis-unsaturated fatty acids for saturated and mono-trans-unsaturated-fatty acids.

In this context, priority must be given to achieving a further reduction in saturated fatty acid consumption, since the discrepancy between the present average amount of saturated fatty acid in the diet and the target amount is greater than the discrepancy seen with mono-trans-unsaturated fatty acids. The necessary change can be brought about by substituting cis-unsaturated fatty acids for saturated

fatty acids wherever possible in commercial food manufacture and in the preparation of foods in the home and by professional caterers. The reduction in saturated fat intake can also be aided by opting for low-fat alternatives to products that make a substantial contribution to that intake. Reducing consumption of foods that are high in saturated fatty acids will also tend to further bring down the amount of cholesterol in the diet. To bring about the desired reduction in dietary mono-trans-unsaturated fatty acid intake, it is important to cut back further on the use of industrially (partially) hydrogenated vegetable oils, particularly in the manufacture of cakes, biscuits and snacks. In addition, the intake of mono-trans-unsaturated fatty acids of animal origin can be reduced by opting for low-fat meat, milk, meat products and dairy produce.

6.2.3 *Essential micronutrients*

The amount of n-3 fatty acids from fish in the national diet needs to be increased significantly to bring it into line with the dietary reference intake of 450 milligrams per day. This level of intake equates to eating two 100-150 gram portions of fish a week, including one portion of oily fish. In practice, this implies substituting fish or fish products for meat or meat products, sometimes at lunch and sometimes as part of one's main meal. As indicated in subchapter 5.8, the consumption of fish oil fatty acid-enriched foods may be an acceptable alternative for people who do not eat fish. The consumption of such foods must always be consistent with the dietary reference intake for n-3 fatty acids from fish. Furthermore, the use of fish oil preparations as source of n-3 fatty acids is not the preferred option from a health point of view.

As indicated in chapter 2, the nutrient density of the national diet has declined over the last ten years, largely as a result of declining consumption of fruit and vegetables. This trend needs to be reversed and fruit and vegetable consumption substantially increased in order to reach the target of 150 to 200 grams of vegetables and 200 grams of fruit. This would improve the supply of essential micronutrients such as folic acid and ß-carotene. It would also boost potassium intake, thus improving the dietary sodium-potassium ratio, which is important for the prevention of high blood pressure.

The national diet may presently fail to provide the dietary reference intakes of iodine, folic acid*, vitamin D** and retinol equivalents. At the request of the

* In order to prevent neural tube defects.
** Young children and older people.

Minister of Health, Welfare and Sport, a Health Council committee is currently preparing a report on this issue.

6.2.4 *Particular types of food*

Anyone on a low-energy diet (< 8 megajoules) should seek to minimise consumption of foods with a high concentration of saturated fatty acids, mono-trans-unsaturated fatty acids or added sugars ('empty calories') and to substitute foods with a high nutrient density. This advice also applies to people with a relatively low energy requirement, such as children and older people.

With a view to managing the risk of dental caries and dental erosion, it is advisable to limit the number of occasions that one consumes foods and drinks containing (easily) fermentable carbohydrates to 7 per day, including the 3 main meals. Furthermore, the prevention of dental erosion will be aided by similarly limiting consumption of foods and drinks with a high concentration of alimentary acids. It is also important to minimise the duration of the associated demineralisation. To this end, foods and drinks of this kind should, where possible, be consumed in combination with others that are rich in components such as calcium and phosphate, which promote remineralisation and aid the buffering effect of the saliva.

Encouraging fruit consumption is not expected to increase the risk of such dental problems, provided that the consumption frequency does not exceed that indicated above. However, the Committee does consider it important to vary the type of fruit consumed. Substituting fruit juices, such as apple juice and citrus fruit juices, for solid fruit is not advisable, because of the increased risk of dental erosion.

As well as boosting the dietary concentration of certain essential micronutrients and fibre, greater fruit and vegetable consumption would improve the dietary sodium-potassium balance. Realisation of the target of 3.4 grams of dietary fibre per megajoule will mean increasing the consumption not only of fruit and vegetables, but also of whole-grain cereal products in place of refined products. Increasing consumption of vegetables, fruit and whole-grain cereal products will reduce the energy density and increase the nutrient density of the diet.

Present levels of salt intake need to be cut substantially if consumption is to be brought within the recommended maximum of 6 grams a day. As well as encouraging less use of salt in domestic food preparation, it will be very important to reduce the amount of salt used in the commercial manufacture of food products and ready-to-eat meals and the use of sodium-containing aromas and flavour enhancers.

Many people presently consume too much alcohol. People who consume alcohol are well advised to limit their intake; adult males should drink no more than two Dutch standard units per day, and adult women no more than one unit. Occasional heavy drinking should be avoided altogether.

6.2.5 *Conclusions*

The Committee recommends that, in the context of disease prevention, the focus should be on overall dietary patterns rather than individual foods or food components. The combination of a balanced diet, adequate physical activity, moderate alcohol consumption and non-smoking is the most effective means of reducing the risk of chronic diseases.

Chapter 7

Policy recommendations

As indicated in subchapter 1.4.3, the *Guidelines for a Healthy Diet 2006* are intended primarily to support the development of food policy and the monitoring of its effects. For practical application in the context of public information provision, these guidelines need to be translated into advice on food intake: the so-called food-based dietary guidelines. As with the *Guidelines for a Healthy Diet 1986*, the Netherlands Nutrition Centre will take on this task. The process of translation needs to take account of ethnic differences in dietary patterns and requirements, and the particular dietary needs of various population groups, such as children, pregnant women, the elderly and people with more or less physically active lifestyles. Also of relevance in this context is whether a person is overweight or gaining weight undesirably.

The existence of evidence-based and practical guidelines does not automatically lead to people eating better or taking more physical activity. Other factors need to be in place to bring such changes about. Both the government and the food and drink industry can influence people's lifestyles in various ways. The Committee has listed a number of the relevant options below. The list is not intended to be exhaustive, and the order in which the various options are listed is not supposed to reflect their priority.

7.1 What can the government do?

A wide range of possible measures is open to the government; the measures in question are best implemented simultaneously as part of a coherent strategy.

- Regulation and public information are classic policy tools. As explained in another Health Council reported published earlier this year, it is vital that public information activities have a sound theoretical and empirical basis*. This applies equally to information about healthy eating and to information about taking sufficient physical activity.
- It is also important that there is no conflict between public information provided by the government and product promotion material issued by the food and drink industry. Appropriate agreements should therefore be made.
- A healthy lifestyle can also be promoted through the educational system. Possibilities are the inclusion in the curriculum of modern, creative forms of dietary education, and fitness and exercise lessons led by qualified tutors in appropriate facilities.
- The government may also be expected to see that foods that are important in the context of the national diet are readily available and affordable for all groups of the population.

7.2 What can the food and drink industry do?

The food and drink industry can also contribute to the promotion of healthier eating in various ways. A valuable guiding principle is that the healthy choice should be the easy choice.

- Good product labelling can help educate the consumer as to the energy value and nutrient content of what he or she is buying.
- In the context of product development and modification, it would be helpful if the food and drink industry considered the recommendations of this report concerning portion sizes and food product composition. Establishments that prepare and serve food, such as catering outlets, restaurants and canteens at schools, factories, offices and sports facilities can also make an important contribution in this regard.

* Health Council. *Plan of campaign. Promotion of healthy behaviour by mass media education.* The Hague: Health Council 2006; No. 2006/16.

Finally, the Committee would draw attention to the scope for the government and the food and drink industry to support and encourage one another in this field. For example, the government could usefully investigate whether and, if so, to what extent the present national and European regulations stand in the way of health-promoting product development and modification.

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Annexes

Annex **A**

Request for advice

On 19 February 1998, the then Vice-President of the Health Council received the following request (reference GZB/VVB/9 8653) from the then State Secretary for Health, Welfare and Sport:

My colleague the Minister of Agriculture, Nature and Food Quality and I hereby ask you to address the following matter:

In 1986, the former Food and Nutrition Council produced a report entitled *Guidelines for a Healthy Diet*. That publication formed the basis for subsequent food policy and for initiatives in the fields of food production and the dissemination of food-related information to the public. In recent years, a number of minor revisions have been made to the guidelines, in line with scientific developments.

More than ten years have passed since publication of the guidelines, and certain aspects of them are now the subject of debate. I would therefore be grateful if the Health Council would start work on the general, periodic review of the guidelines referred to in the annual plan for 1998. I understand that it will not be possible to complete this review in the short term. My suggestion therefore is that a revised version of the guidelines should be published in the year 2000 and that the guidelines should thereafter be updated every five years, in addition to any revisions that may be necessitated in the interim.

Please let me know whether the Council is able to act upon this proposal.

With kind regards,

[signature]

Erica Terpstra,

State Secretary for Health, Welfare and Sport

Annex **B**

The committee

- prof. dr. F.J. Kok, *chairman*
  professor of nutrition and health; University of Wageningen
- prof. dr. J.J. van Binsbergen
  general practicionar, professor of nutrition; UMC St Radboud, Nijmegen
- B.C. Breedveld
  head of research; Netherlands Nutrition Center, The Hague
- prof. dr. H.A. Büller
  professor of paediatrics; ErasmusMc, Rotterdam
- dr. E.J.M. Feskens
  associate professor of nutrition and epidemiology; University of Wageningen
- A.M. van der Greft, *advisor*
  Ministry of Health Welfare and Sport, The Hague
- dr. S. de Henauw
  epidemiologist; department of public health, University of Gent
  (until april 2006)
- dr. E. Kampman
  associate professor of nutrition and epidemiology; University of Wageningen
- dr. O. Korver
  former director of nutrition research Unilever, Rotterdam
- W. Bosman, *secretary*
  Health Council of the Netherlands, The Hague

Administrative support:
C. Nederpelt-Brussee, Health Council of the Netherlands, The Hague

Lay-out:
M. Javanmardi, Health Council of the Netherlands, The Hague
J. van Kan, Health Council of the Netherlands, The Hague

The Health Council and interests

Members of Health Council Committees are appointed in a personal capacity because of their special expertise in the matters to be addressed. Nonetheless, it is precisely because of this expertise that they may also have interests. This in itself does not necessarily present an obstacle for membership of a Health Council Committee. Transparency regarding possible conflicts of interest is nonetheless important, both for the President and members of a Committee and for the President of the Health Council. On being invited to join a Committee, members are asked to submit a form detailing the functions they hold and any other material and immaterial interests which could be relevant for the Committee's work. It is the responsibility of the President of the Health Council to assess whether the interests indicated constitute grounds for non-appointment. An advisorship will then sometimes make it possible to exploit the expertise of the specialist involved. During the establishment meeting the declarations issued are discussed, so that all members of the Committee are aware of each other's possible interests.

Annex C

Participants of the working conferences

The working conferences were presided by professor D. Kromhout, vice-president of Health Council of the Netherlands, and scientifically supported by E.J. Schoten, secretary at the Health Council of the Netherlands.

Working conference on physical activity (March 7, 2006)

Invited participants:

- Dr. M. van Baak, associate professor of human biology, University of Maastricht
- Dr. M. Chin à Paw, physical activity scientist, Free University Medical Center, Amsterdam
- E.L. Engelsman, ambassador 'physical activity and health', Ministry of Health, Welfare and Sport, The Hague
- prof. dr. H.C.G. Kemper, em. professor of physical activity sciences, Free University Medical Center, Amsterdam
- Dr. L.C.J. van Loon, associate professor of physical activity sciences, University of Maastricht
- prof. dr. W.L. Mosterd, em. professor of sports medicine, UMC Utrecht
- W.T.M. Ooijendijk, physical activity scientist, TNO Kwaliteit van Leven, Leiden
- Dr. G. Plasqui, physical activity scientist, University of Maastricht

- Dr. A.J. Schuit, senior research scientist, National Institute of Public Health, Bilthoven
- prof. dr. J.C. Seidell, professor of nutrition and health, Free University Medical Center, Amsterdam

The following members of the Committee were present:
- W. Bosman
- prof. dr. F.J. Kok
- dr. E.J.M. Feskens
- dr. O. Korver

Working conference on fish oil fatty acids (March 16, 2006)

Invited participants:
- S.J. van Dis, policy advisor Netherlands Heart Foundation, The Hague
- Dr. J.M. Geleijnse, assistant professor of nutrition and epidemiology, University of Wageningen
- prof. dr. G. Hornstra, em. professor of experimental nutrition, University of Maastricht
- prof. dr. A.F.H. Stalenhoef, professor of internal medicine, UMC St Radboud, Nijmegen
- Dr. P.L. Zock, teamleader dietary fats and health, Unilever Research Laboratory, Vlaardingen

The following members of the Committee were present:
- prof. dr. J.J. van Binsbergen
- W. Bosman
- B.C. Breedveld
- prof. dr. F.J. Kok
- dr. E.J.M. Feskens
- dr. O. Korver

Working conference on vegetables and fruits (April 20, 2006)

Invited participants:
- prof. dr. A. Bast, professor of human toxicology, University of Maastricht
- Dr. R.A. Bausch-Goldbohm, epidemiologist, TNO Kwaliteit van Leven, Zeist
- Dr. H. van den Berg, policy advisor Netherlands Nutrition Centre, The Hague

- Dr. M.C.J.F. Jansen, epidemiologist, TNO Kwaliteit van Leven, Zeist
- Dr. C.M.F. Kneepkens, paediatrician, Free University Medical Center, Amsterdam
- Dr. M.C. Ocké, senior research scientist, National Institute of Public Health, Bilthoven

The following members of the Committee were present:
- prof. dr. J.J. van Binsbergen
- W. Bosman
- dr. E. Kampman
- prof. dr. F.J. Kok