# Dietary reference values for vitamins and minerals for adults

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

# contents

# Executive summary

The Health Council of the Netherlands has formulated dietary reference values for 25 vitamins and minerals for adults. For that purpose, the Council's Committee on Nutrition evaluated the European Food Safety Authority's (EFSA) recently released dietary reference values to determine whether they can be applied in the Netherlands. This advisory report only concerns the dietary reference values for adults. In later advisory reports, the Council will explore the dietary reference values for infants, children, pregnant women, and lactating women, tolerable upper intake levels and the dietary reference values for proteins, carbohydrates and fats.

**Dietary reference values**

Dietary reference values provide information about the intake of nutrients that the body needs to function properly and prevent disease. The parameters from which dietary reference values are derived are based on healthy individuals with a healthy weight. Dietary reference values are used in public information on nutrition, for the detection of groups who are at risk of having deficiencies, when providing advice on dieting, and and in planning diets for individuals and groups. Dietary reference values also play a role in the regulations on nutrition labelling.

**Evaluation of the EFSA dietary reference values**

When evaluating the EFSA dietary reference values, three questions were key:

- Should the EFSA reference values be rejected based on a specific nutritional context in the Netherlands that differs from (the rest of) Europe?
- Are there objections to the scientific basis used by EFSA for this specific nutrient?
- Do (part of) the EFSA reference values differ 10% or more from the 2014 values for the Netherlands?

**The new dietary reference values for adults**

The Committee distinguishes between dietary reference values based on relatively strong evidence and values based on weak evidence. Approximately half of the EFSA dietary reference values based on relatively strong evidence can be adopted. In these cases, the Committee agrees with the scientific basis used by EFSA or this specific nutrient and the Dutch context provides no reason for deviating from the EFSA dietary reference values. With regard to the other vitamins and minerals, the Committee has decided either to maintain or modify existing Dutch dietary reference values, or not to formulate a dietary reference value at all. For three nutrients, this is related to a specific nutritional context in the Netherlands. The EFSA dietary reference values for seven other nutrients were not adopted, because the

Committee has objections to the scientific basis used by EFSA. Usually, these EFSA dietary reference values were higher than the current Dutch dietary reference values, without sufficient evidence that a higher intake would lead to genuine health gains. These nutrients could then feature too prominently in public information on nutrition, and when formulating healthy diets (food patterns that comply with the Dutch dietary guidelines 2015 and with all relevant dietary reference values).

The Committee's conclusions are summarised in Table 1. It also indicates whether the conclusion implies that the existing Dutch reference values are changed.

For eight other nutrients, a lack of research prevents the EFSA dietary reference values from being properly assessed. As a result, it is also impossible to derive a better dietary reference value. In view of the efforts to harmonise dietary reference values throughout Europe, the Committee has decided to adopt EFSA dietary reference values for these . substances, even though they are based on weak evidence (see Table 2). A dietary reference value is needed for these substances because they are essential nutrients that the body requires but cannot produce itself. In practice, these dietary reference values have little relevance for the general population as there do not appear to be any deficiencies of the nutrients in question. The Committee, therefore, recommends that these dietary reference values are not used in public information on nutrition or for assessments of the diets of specific groups. These dietary reference values, however, can be used for dietary planning.

**Table 1.** Conclusions regarding relatively strongly substantiated dietary reference values

| | Change compared to 2014 | | | |
|---|---|---|---|---|
| | Higher value | Lower value | Another type of change | No change |
| Adopted from EFSA | • Riboflavin<br>• Iron (population reference intakes)<br>• Potassium (women)<br>• Magnesium (women) | • Iron (average requirements) | • Thiamin and niacin: unit has changed<br>• Calcium (young people) and iodine: type of reference value has changed | • Vitamin K1<br>• Potassium (men)<br>• Magnesium (men) |
| Not adopted from EFSA | • Vitamin A (average requirements) | • Vitamin A (population reference intakes) | • Fluoride: no reference value required in the Netherlands | • Vitamin B6<br>• Folate<br>• Vitamin B12<br>• Vitamin C<br>• Vitamin D<br>• Calcium (older adults)<br>• Copper<br>• Zinc |

**Table 2.** Conclusions about weakly substantiated dietary reference values

| | Change compared to 2014 | | |
|---|---|---|---|
| | Higher value | Another type of change | No change |
| Adopted from EFSA | • Vitamin E<br>• Selenium | • Choline: no dietary reference value in 2014<br>• Phosphorus: type of dietary reference value has changed | • Pantothenic acid<br>• Biotin<br>• Manganese<br>• Molybdenum |

**Limitations of the dietary reference values**

Dietary reference values are an important tool for determining whether people are consuming enough vitamins and minerals. Dietary reference values also have clear limitations, which means they must not be used too rigidly in everyday practice. For instance, even in the case of relatively strong evidence, available research is not always good enough to assess whether the requirement differs between men and women or between younger and older adults. If there is too little research, or none at all, then the same reference value is often used for all adults. It would then be wrong to conclude, on the basis of that reference value, that women – who eat on average less and have a lower nutrient intake than men – are at greater risk of inadequate supply than men.

Dietary reference values are intended primarily for healthy individuals with a healthy body weight. Research on the nutritional requirements of other groups, such as the chronically ill, older adults (indeed, many older individuals in the Netherlands have one or more chronic disorders) or obese individuals, is often limited. In the absence of specific recommendations for groups like these, it is customary to use the dietary reference values, even though they primarily are intended for healthy people with a healthy body weight.

# 01 introduction

## 1.1 Background

Dietary reference values provide information about the amounts of vitamins, minerals, proteins, carbohydrates and fats that healthy people need to consume to remain healthy. Dutch dietary reference values are derived by the Health Council.[1]

The most recent Dutch dietary reference values were published in 2012 (vitamin D[2]) and in the period from 2000 to 2003 (proteins, carbohydrates and fats[3], B vitamins[4,5] and calcium[4]). The Dutch dietary reference values for the other vitamins and minerals were older than this, and in 2014, the Health Council advised that temporary use be made of other organisations' reference values.[6] At that time, the Council announced that it would evaluate the European Food Safety Authority's (EFSA) dietary reference values when these had become available.[6] That has been the case since September 2017.[7-40]

In the evaluation, the key issue is whether there are any objections to the use of EFSA dietary reference values in the Netherlands.[1] The evaluation is carried out in stages. This first advisory report covers the evaluation of the dietary reference values for vitamins and minerals for adults (aged 18 and above). It relates to 27 substances. The evaluation, which was carried out by the Committee on Nutrition, was prepared by the Working Group on Dietary reference values, which was appointed for this purpose. The names of the Committee members and those of the Working Group are listed at the end of this advisory report. The Standing Committee on Public Health reviewed a draft of the advisory report. The President of the Council then presented it to the State Secretary for Health, Welfare and Sport.

**Harmonisation within the European Union as the basic principle**

The basic principle is the goal of harmonising dietary reference values throughout the European Union. For most vitamins and minerals, the dietary reference values derived for Europe as a whole may also be applicable in the Netherlands. Dietary reference values are more usually established for large regions, for instance the United States and Canada use the same reference values[41], and the WHO/FAO[42] dietary reference values are intended for use in a wide range of countries.

## 1.2 What are dietary reference values?

In 2015, the Health Council published the advisory report entitled 'Dutch dietary guidelines 2015'. In this document, the Council specified recommended levels of consumption for foods and beverages, to prevent the ten most important chronic diseases.[43,65]

Dietary reference values are not focussed on foods and beverages, as such, but rather on the substances they contain – vitamins, minerals, proteins, fats and carbohydrates.

Nutrients are referred to as 'essential' if their consumption, as part of the diet, is vital for the maintenance of good health. Each essential nutrient has one or more specific physiological functions in the body. The human body cannot produce these nutrients, or cannot produce them in sufficient

quantities. If the intake levels of these vitamins or minerals are too low, then symptoms of deficiency may develop and/or there may be an increased risk of disease. Most dietary reference values are aimed at preventing nutrient-specific deficiency symptoms. For this reason, they are supplementary to the Dutch dietary guidelines 2015. Dietary reference values provide information about the nutrient intake that the body needs to function properly or to prevent diseases, and about the highest intake level that is considered safe.

There are four types of dietary reference value: 1) the average requirement, 2) the population reference intake, 3) the adequate intake and 4) the tolerable upper intake level (see Figure 1 and the box labelled ‘Types of dietary reference value’).

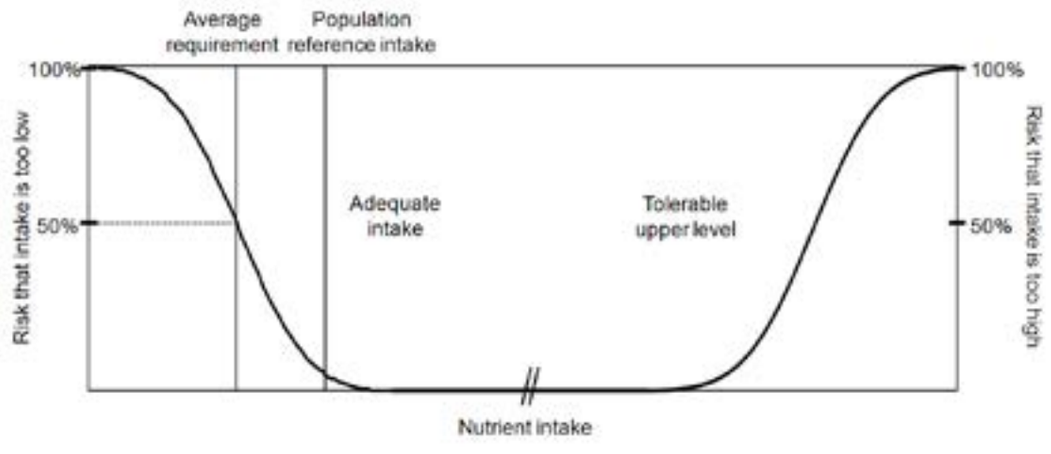


**Figure 1.** The types of dietary reference value in relation to the nutrient intake (X axis) and the probability that this intake will be too high or too low (Y axis)

**Types of dietary reference value**

There are various types of dietary reference values:

1. The ‘average requirement’ is the intake level at which 50% of people would have enough for their own requirements, but the other 50% would not. Average requirements are always relatively strongly substantiated.
2. The ‘population reference intake’ is the level that is considered adequate for virtually everyone in the population group in question. By definition, this reference value is only established if there is sufficient data from scientific research to be able to estimate an average requirement. Accordingly, this also involves relatively strong substantiation. In theory, the population reference intake is the intake level that is adequate for exactly 97.5% of the group concerned. However, because of uncertainties in the studies upon which the average requirements and population reference intakes are based, it is better to express this as ‘virtually’ everyone in the population group in question.
3. The ‘adequate intake’ is a level of intake that can be assumed to meet the needs of virtually everyone in the population group in question. This type of dietary reference value is established if neither the average requirement nor – as a result – the population reference intake can be determined. Adequate intakes are sometimes relatively strongly substantiated and sometimes weakly substantiated.
4. The ‘tolerable upper intake level’ is the highest intake level at which long-term exposure is not expected to produce any harmful overdosage effects. The tolerable upper intake level is not the ideal intake level, as raising intake above the population reference intake or adequate intake, is not expected to produce any further health gains. Moreover, intakes in excess of the tolerable upper intake level are potentially unhealthy.

This advisory report concerns dietary reference values related to the risks of intakes which are too low: the average requirements, population reference intakes and adequate intakes. Where possible, average requirements and population reference intakes are derived. If this is not possible based on the available research, an adequate intake will be derived instead.

A tolerable upper intake level is derived if there is sufficient evidence that a high intake can produce adverse effects. These will be discussed in a later advisory report, in accordance with EFSA practices.[47-50] This is because the adverse effects targeted by the upper intake levels are not the same as those targeted by the lower levels. Accordingly, different scientific publications are involved.

## 1.3 Basic principles for the formulation of dietary reference values

Dietary reference values relate to the average conditions in larger groups. At group level, differences between people (in terms of their dietary pattern, personal characteristics, and living conditions) that might influence the needs of the individual tend to average out.

Dietary reference values are intended primarily for healthy individuals with a healthy body weight. To this end, reports on dietary reference values define reference weights for adults (usually based on the average heights of men and women in the target population). The reference weight is a healthy weight for people of those average heights and is based on their *body mass index*.[a]

In the Netherlands, however, many people are overweight and even obese. And many adults, especially older adults, suffer from one or more chronic diseases. In its Dutch Public Health Foresight Trend Scenario, the National Institute for Public Health and the Environment (RIVM) stated that, in 2015, 50% of the population of the Netherlands suffered from at least one chronic condition.[51] While certain diseases, certain types of medicine use, and being overweight may affect people's requirements for specific nutrients, knowledge about this is limited. Medical professional associations have formulated modified (i.e. different and distinct) recommendations for certain groups.[52] The Committee did not assess these disease-specific recommendations. If no specific dietary guidelines or recommendations are available for a given group, then the dietary reference values are generally used. Dietary reference values are also used when assessing the intake of representative population groups comprising individuals with healthy weights and others who weigh too much or too little.

Another basic principle is that, when deriving a dietary reference value, the intake of other nutrients is assumed to be sufficient.

## 1.4 Application of the dietary reference values

Dietary reference values have a wide range of applications.

- The Netherlands Nutrition Centre bases its public information on nutrition (including the 'Wheel of Five' and examples of healthy daily diets) on both the Dutch dietary guidelines 2015 and on the dietary reference values (the population reference intakes and adequate intakes). Compliance with the Dutch dietary guidelines 2015 does not automatically equate with compliance to the dietary reference values.

[a] The *body mass index* (BMI) is the body weight in kilograms divided by the square of the individual's height in metres. A healthy weight for a given height corresponds to a BMI of between 18 and 25.

For example, the Netherlands Nutrition Centre's guideline level for vegetables is higher than the level indicated in the Dutch dietary guidelines 2015, because this was required for the compliance with the dietary reference values.

- The National Institute for Public Health and the Environment (RIVM) uses the dietary reference values – together with data from Dutch food consumption surveys – to evaluate the Dutch population's intake levels. In the context of this application, the average requirement and the population reference intake are more suitable than the adequate intake. If high-risk groups are identified on the basis of dietary reference values, then confirmation is required based on research into the nutritional status (e.g. specific blood values) or the prevalence of clinical symptoms.
- Healthcare professionals, such as dietitians and physicians, use dietary reference values (population reference intakes and adequate intakes) when advising individuals about healthy eating habits or diet.
- Dietary reference values are valuable in situations where food is rationed, such as emergency aid or military exercises.
- Dietary reference values are considered in regulations on the fortification of foods and the composition of supplements.
- Dietary reference values are used in the product composition information on food labels.

Because the recommended quantities and adequate intakes are considered adequate for a sufficient intake in virtually everyone in the population group in question, these dietary reference values are used for applications at the level of the individual: if a person's intake is higher than the population reference intake or adequate intake (and lower than the tolerable upper limit), it can be considered adequate. However, if an individual's intake is below the population reference intake or adequate intake level this does not necessarily mean it is insufficient for that specific individual. In such cases, additional data (from blood tests, for example) is needed to determine whether the intake level is sufficient. Further details about the method of application can be found in reports by the EFSA[40] and the Institute of Medicine (IOM)[53-55].

## 1.5 Reading guide

In Chapter 2, the Committee describes the method used when evaluating EFSA dietary reference values. Chapter 3 describes the evaluation's findings, which are reported in greater detail in the background document entitled *An evaluation of the EFSA's dietary reference values, Part 1: Dietary reference values for vitamins and minerals for adults,* which can be found at www.gezondheidsraad.nl. In Chapter 4, the Committee explores the significance of the dietary reference values for the Netherlands. Here, it also touches on differences in the applicability of the various dietary reference values.

## 1.6 Follow-up

This first advisory report concerns adults. This is because, for most nutrients, the associated scientific research tend to focus mainly – and sometimes exclusively – on adults. The dietary reference values for other groups (infants, children, pregnant women, and lactating women) are often derived – to some extent – from these values for adults.

The following topics will be addressed in subsequent advisory reports:

- the dietary reference values for vitamins and minerals for the other groups mentioned above
- the dietary reference values for macronutrients (nutrients that contribute to the energy supply – proteins, carbohydrates and fats) for all groups
- the tolerable upper intake levels for vitamins and minerals, for all groups.

# 02 methodology

The Committee has considered whether there are objections to the use of EFSA dietary reference values in the Netherlands. In addition to the current Dutch dietary reference values and EFSA dietary reference values, the evaluation used the most relevant (for the Netherlands) international reports on dietary reference values.

## 2.1 How dietary reference values are derived

Dietary reference values are based on a range of data, depending on the nutrient in question. The Committee distinguishes between relatively strongly substantiated and weakly substantiated dietary reference values.

**Relatively strongly substantiated dietary reference values**

For vitamins, dietary reference values often target the intake level considered necessary to prevent symptoms of deficiency or diseases. This level of intake can be studied directly (i.e. based on research into the relationship between the intake level and the symptoms of deficiency or diseases), but it is more often studied indirectly. The latter approach could, for example, be based on the relationship between nutrient intake and the concentration of that nutrient (or one of its biomarkers) in the blood. For minerals, dietary reference values often target the intake level needed to maintain the body's stores. Only a few dietary reference values have been derived on the basis of an extensive body of good quality research. Some are based on just one or a few good quality research studies. For this reason, the Committee refers to dietary reference values with *relatively strong* substantiation. These dietary reference values are described in Sections 3.1 and 3.2.

**Weakly substantiated dietary reference values**

For some nutrients, none of the abovementioned methods for deriving dietary reference values can be used. This is either because those methods are not suitable, or because little, if any, research has been published in which suitable methods were used. In all cases, these weakly substantiated dietary reference values are adequate intake. Usually, these are primarily or even exclusively based on average and median intakes, occasionally on other research data, or on assumptions that form a weak substantiation. These dietary reference values are described in Section 3.3. They have little relevance for the general population because there do not appear to be any deficiencies of these nutrients. Accordingly, the Committee recommends that these dietary reference values should not be used for public information on nutrition or for assessments of the diets of population groups.

**Differences in the weighting of available research**

Given the importance of harmonisation, the Committee has checked to see whether there were objections to the EFSA dietary reference values from a scientific point of view.[7-34] For some nutrients, the Committee weighted the scientific research underpinning the derivation of the dietary reference values differently from the EFSA. Accordingly, the EFSA dietary

reference values were not adopted in these instances. In cases like this, the Committee generally recommends that the existing Dutch dietary reference value be retained. These dietary reference values are described in Section 3.2. All such dietary reference values are relatively strongly substantiated; in regard to the weakly substantiated dietary reference values, there is too little research available and the uncertainties involved are too great to derive a better substantiated reference value.
Differences in the weighting of the available research occasionally leads to dietary reference values that are higher than those derived by the EFSA. In such cases, the Committee concluded that a higher intake could deliver additional health gains. More often, however, the dietary reference value formulated by the Committee is lower than the one derived by the EFSA. In those cases, the Committee feels there is insufficient evidence that intake levels in line with the higher EFSA dietary reference values are better for people's health. The Committee considers it important that dietary reference values should not be set at unnecessarily high levels. In cases where there is insufficient substantiation, allegations that intakes are too low may give rise to undue concern. These nutrients can also feature too prominently in public information on nutrition, and when formulating healthy diets (food patterns which comply with all Dutch dietary guidelines 2015 and all relevant dietary reference values).

## 2.2 Comparison of six reports

The Committee has evaluated the EFSA dietary reference values based on a comparison with five other reports on dietary reference values that it deemed most relevant to the Dutch situation. The Health Council's dietary reference values are relevant because these were applicable to the Netherlands during the advisory process.[2-6] Two other reports are relevant because they relate to dietary reference values for larger European regions. The first is the *Nordic Nutrition Recommendations*, for the Scandinavian countries published by the Nordic Council of Ministers (NCM)[44]. The second is the *Referenzwerte für die Nährstoffzufuhr* (Nutrient Supply Reference Values) for the group of German-speaking countries jointly referred to as the DACH nations: Germany (D), Austria (A) and Switzerland (CH).[45] The reports on *Dietary Reference Intakes* for the United States and Canada by the US Institute of Medicine (IOM[a]) describe how dietary reference values are derived in the US and Canada.[46,56-60] A joint WHO/FAO[42] report entitled *Vitamin and mineral requirements in human nutrition* is also intended for use in a wide range of countries. The latter report mainly targets non-Western countries with physically active, relatively young populations, sometimes suffering from clinical deficiencies stemming from inadequate nutrition. As a result, these dietary reference values may deviate from the dietary reference values used in Western countries.

[a] In March 2016, the Institute of Medicine was renamed Health and Medicine Division.

Each of these reports gives a step by step description of the scientific knowledge about the nutrient in question. First, they examine various approaches that could theoretically be used to derive the dietary reference value. They go on to provide reasoned arguments to show which of these is best. They then describe which of the available research could be used to derive the dietary reference values using that method. The description ultimately leads to a well-substantiated selection of studies (often only a few) which serve as the basis for deriving the dietary reference values. There are a remarkably large number of differences: for almost each and every vitamin and mineral there are differences between reports. These differences are sometimes very substantial, as in the cases of vitamins A, C, D, and E, and of potassium and selenium. The only nutrient about which the reports come close to agreement is iodine.

## 2.3 The background document

The background document to this advisory report contains a comprehensive description of the evaluation. In this background document, the Committee describes how the EFSA dietary reference values (for each individual nutrient) differ from the reference values listed in the other five reports. It then proceeds to describe the reasons for these differences. This approach leads to a focus on the specific studies that were actually used to derive the dietary reference values in the reports. The differences between the reports often result from disparities in the selection and interpretation of the available research. This approach

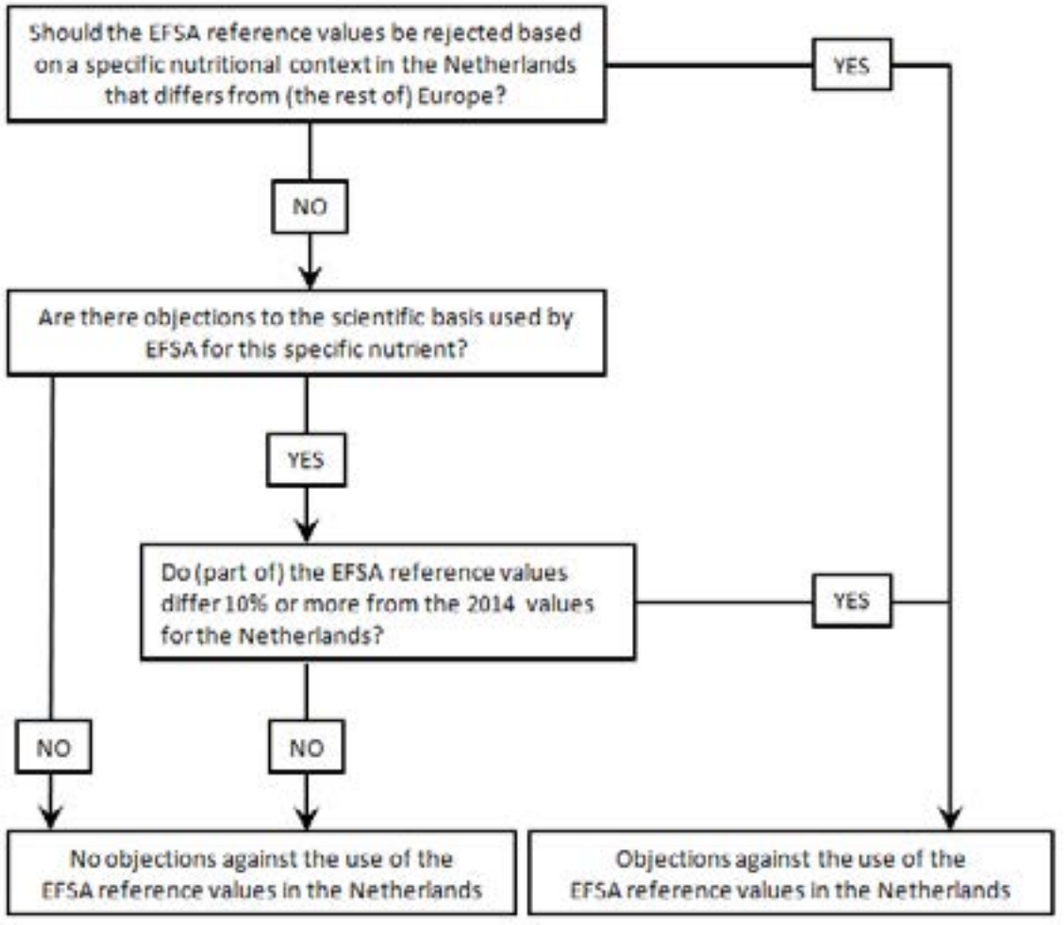


**Figure 2.** Assessment of the EFSA dietary reference values

helped the Committee to understand the various uncertainties and points of dispute associated with the process of setting dietary reference values. The Committee then assessed the scientific basis for the EFSA's dietary reference values. In this connection, three questions were key:

- Should the EFSA reference values be rejected based on a specific nutritional context in the Netherlands that differs from (the rest of) Europe?

- Are there objections to the scientific basis used by EFSA for this specific nutrient?
- Do (part of) the EFSA reference values differ 10% or more from the 2014 values for the Netherlands?

Based on the first two questions, there could well be objections to the EFSA dietary reference values. If the answer to the third question was ‘no’, this was taken as an argument that – in case of doubt – the EFSA dietary reference value should be adopted. These objections are discussed and explained in Section 3.2.

## 2.4 Comparison of the dietary reference values with normal intake levels in the Netherlands

At the same time as this advisory report was published, the RIVM published a comparison of the usual (habitual) intake of Dutch adults aged from 18 to 50 years with the 2014 Dutch dietary reference values and with the EFSA’s reference values.[61] A draft version of this report was available during the evaluation. The report is based on intakes from the 2007-2010 Dutch National Food Consumption Survey. Consumption data alone conveys nothing about nutrient requirements. For this reason, the Committee has used this data as background information only and not as an argument for whether or not to adopt the EFSA dietary reference values in the Netherlands.

# 03 assessment of the EFSA dietary reference values

For eighteen of the vitamins and minerals there is relatively strong substantiation. The Committee concludes that the EFSA dietary reference values can be adopted for about half of these nutrients. With regard to the other nutrients, the Committee feels it is better either to retain current Dutch dietary reference values, to use a modified dietary reference value or not to formulate a dietary reference value at all.
There are eight vitamins and minerals for which the substantiation is weak. The Committee has concluded that, given the available scientific knowledge, it is not possible to improve this substantiation any further, thus these dietary reference values are adopted by default.

## 3.1 EFSA dietary reference values that are considered sufficiently substantiated

For nine nutrients, the Committee adopted the EFSA dietary reference values, because these are well substantiated and fit within the Dutch context. These are:

- thiamine (vitamin B1)
- riboflavin (vitamin B2)
- niacin (vitamin B3)
- vitamin K1 (phylloquinone)
- calcium for women aged 18 to 50 years and men aged 18 to 70 years (but not for older men and women)
- iodine
- iron
- potassium
- magnesium.

Furthermore, the Committee concurs with EFSA's decision not to formulate a dietary reference value for trivalent chromium.

### Substantiation of the EFSA dietary reference values adopted for the Netherlands by the Committee

For two substances, the EFSA dietary reference values focus on the intake level needed to maintain the body's stores. The substances in question are calcium (for women aged 18 to 50 years and men aged 18 to 70 years) and iron.
For thiamine, riboflavin, niacin, vitamin K1 and iodine, the EFSA dietary reference values target the intake level that is considered necessary (albeit indirectly) to prevent specific symptoms developing which result from deficiencies in these substances, such as an enlarged thyroid gland in the case of iodine deficiency.
The EFSA dietary reference values for potassium and magnesium are aimed (in part) at the prevention of chronic diseases. Accordingly, they are higher than is strictly necessary to prevent the nutrient-specific symptoms of deficiency. The effect of potassium intake on the risk of stroke is strongly substantiated by the consistent picture in the available publications of observational and experimental studies. For magnesium, limited evidence from observational studies indicated that a higher intake is associated with a lower risk of developing chronic diseases. For this

and other reasons, the EFSA decided to base the dietary reference values for magnesium on consumption data.

## 3.2 EFSA dietary reference values that are considered insufficiently substantiated or insufficiently applicable to the Dutch situation.

For ten of the nutrients, the Committee believes that the associated EFSA dietary reference values are either too high or too low, given the specific context in the Netherlands or the available scientific evidence. In these cases the Committee either maintained the existing Dutch dietary reference values, or opted for an alternative solution.

**EFSA dietary reference values where objections concern the specific context in the Netherlands**

- vitamin A (retinol)
- calcium for women over the age of 50 years and men over the age of 70 years (but not for younger men and women)
- fluoride.

For vitamin A, calcium in older adults, and fluoride, the associated EFSA dietary reference values are not sufficiently in keeping with the average situation in the Netherlands. For vitamin A, the Committee has largely adopted the EFSA's method for formulating dietary reference values. However, it has used a higher body weight, because the average Dutch person is taller (and therefore heavier) than the average European.[62] This higher reference weight was used for vitamin A alone, to adjust the dietary reference value to the Dutch situation. There was no reason to do this for any other nutrients.

The EFSA dietary reference value for calcium is not adequate for women over the age of 50 years or for men over the age of 70 years. This is because, in the Netherlands, the use of a vitamin D supplement is recommended for these groups. This dietary supplementation is ineffective if the calcium intake involved is at the level of the EFSA adequate intake. A higher calcium intake is required.[2,63]

With regard to fluoride, the Committee does not consider it appropriate to apply a dietary reference value in the Netherlands. This is because caries prevention in the Netherlands involves the use of fluoride-containing toothpastes and gels, rather than fluoride intake.

**EFSA dietary reference values where the objection concerns substantiation**

- vitamin B6
- folate
- vitamin B12 (cobalamin)
- vitamin C (ascorbic acid)
- vitamin D (ergocalciferol and cholecalciferol)
- copper
- zinc.

For these seven substances, the Committee has maintained the existing Dutch dietary reference values for another reason. The EFSA dietary reference values for these substances are generally higher than the current Dutch reference values. In these cases, however, the Committee feels there is insufficient evidence that a higher EFSA dietary reference value would deliver additional health gains.

This can be clearly explained on the basis of nutrients whose dietary reference values target the intake required to keep relevant blood parameters at the correct level (vitamin B6, folate and vitamin C). In such cases, the level considered optimal for health determines the level of the associated dietary reference value. The Committee uses a lower target level for these blood values than the EFSA. It considers that there is insufficient evidence for adopting the EFSA's higher target levels. The EFSA's argument for using these higher blood values is that they reflect an extensive (or more extensive) supply of nutrients. However, the Committee considers that there is no or insufficient scientific evidence that this larger provision of nutrients is indeed necessary for health. The existing Dutch dietary reference values are based on lower blood values; clinical symptoms of deficiency are unlikely at these blood value levels.

The Committee has the same objection in regard to the EFSA dietary reference values for vitamin D in individuals aged 18 to 69 years. In addition, it considers the statistical method used by the EFSA to be less appropriate. The existing Dutch dietary reference value for vitamin D is based on the blood target level and statistical method preferred by the Committee. Another factor taken into consideration when determining the existing dietary reference value was that there is no evidence that every Dutch adult needs vitamin D supplements. With regard to older adults, the Committee considers the EFSA dietary reference value for vitamin D to be too low. Scientific data indicates that a higher intake is beneficial to this group to prevent fractures.

The EFSA dietary reference values for vitamin B12, copper and zinc are, according to the Committee, insufficiently substantiated. This is because little relevant research has been published, or because of the way that the results of available research have been interpreted.

**Substantiation of dietary reference values that differ between the Committee and the EFSA**

For vitamin A, vitamin B6, folate, vitamin B12 and copper, the dietary reference values target the intake level (albeit indirectly) considered necessary to prevent symptoms of deficiency.

With regard to folate, the Committee points out that the advice to women of childbearing age (to start using folic acid supplements at least four weeks prior to conception) is supplementary to the dietary reference value.

Preventive effects against chronic diseases are taken into account when setting reference values for vitamin C, for vitamin D in adults aged 70 years and above, and for calcium in women over the age of 50 years and in men over the age of 70 years. For vitamin D and calcium, substantiation

is based on experimental evidence. In the case of vitamin C, this was restricted to observational evidence alone.
The dietary reference values for zinc target the intake needed to maintain the body's stores.

## 3.3 EFSA dietary reference values that are difficult to assess

Some EFSA dietary reference values are difficult to assess because of the limited scientific evidence. The nutrients in question unequivocally require dietary reference values because it is clear that people need a specific, adequate level of intake to stay healthy. They cannot be produced by the body but have important physiological functions. However, due to the lack of scientific data, it is impossible to substantiate why a different value would be superior to the dietary reference value set by the EFSA. None of the currently available methods and evidence enables the derivation of better-quality dietary reference values. Because harmonisation within the European Union is the basic principle here, the Committee has adopted these EFSA dietary reference values.
These are:

- pantothenic acid
- vitamin E
- biotin
- choline
- phosphorus
- manganese
- molybdenum
- selenium.

It is clear that every one of these nutrients is necessary for the body to function properly. However, with regard to most of these substances, there does not appear to be any clinical symptoms of deficiency in the general population of the Netherlands. Where clinical symptoms of deficiency were reported, these were almost never entirely the result of an excessively low intake. Deficiencies have sometimes been identified in individuals who have specific diseases or genetic defects, in individuals receiving long-term parenteral nutrition (artificial nutrition that is introduced directly into the bloodstream), or, in the case of biotin, in individuals with unusual dietary habits (when large numbers of raw eggs are consumed the body absorbs little or no biotin from food).
The level of knowledge about these substances is limited but – based on the available research – there is no reason to be concerned about the intake. Accordingly, these adequate intakes are less relevant than the dietary reference values for the nutrients described in Sections 3.1 and 3.2. It is better not to use these dietary reference values in public information on nutrition or for assessments of the diets of specific groups.

### Substantiation of these EFSA dietary reference values

In six of these nutrients, the EFSA's adequate intakes are primarily, or even exclusively, based on average and median intakes in European countries (pantothenic acid, vitamin E, biotin, choline, manganese and

molybdenum). The Committee points out that EFSA has set the dietary reference value for molybdenum at a relatively low level compared to the other five nutrients. This is because molybdenum's reference value was based on populations with the lowest average intake estimates, while the other five were based on all populations for which intake estimates were available.

The EFSA adequate intake for phosphorus is based on the population reference intake for calcium and on a weakly substantiated hypothesis concerning the ideal ratio between the levels of calcium and phosphorus in the diet.

The EFSA adequate intake for selenium targets the intake needed to maximise a given blood value. The EFSA does not provide clinical evidence for this target blood value, but mentions that a limited number of observational studies into the association between this particular blood value and cancer seem to support this approach. The EFSA adequate intake for selenium is higher than that cited in the other reports but there is only limited evidence that this relatively high intake can deliver additional health gains. Therefore, this is also a weakly substantiated dietary reference value.

# 04
# the new Dutch dietary reference values and their significance

The importance of dietary reference values stems from the applications described earlier in this advisory report. Dietary reference values have limitations, which means they must not be applied too rigidly in everyday practice. This is particularly applicable to weakly substantiated dietary reference values. The Committee also concludes that it is not always clear why men and women have different dietary reference values in some cases but not in others.

## 4.1 The dietary reference values derived for the Netherlands in this advisory report

Most of the new Dutch dietary reference values were adopted from the EFSA. In cases where the Committee adopts other dietary reference values because it has objections to EFSA dietary reference values, this is usually motivated by a different weighting of the current level of knowledge, and sometimes by the specific context in the Netherlands. The dietary reference values for ten vitamins and seven minerals are relatively strongly substantiated. The dietary reference values used for about half of these substances were adopted from the EFSA reference values (Table 3). The adequate intakes for the remaining nutrients are weakly substantiated, and have all been adopted from the EFSA (Table 4).

## 4.2 Impact of the changes for implementation

For most nutrients the type of dietary reference value involved remains the same, but for some it has changed. In addition, the Committee has now specified whether adequate intakes have a relatively strong substantiation or a weak substantiation. That has some implications for the application:

- For calcium, an average requirement and population reference intake are now available for younger adults (this was previously an adequate intake). As a result, based on these new dietary reference values, population-level assessments of calcium intake in younger adults can now deliver more tangible conclusions than was possible using the previous reference values.
- For iodine, the type of dietary reference value involved has been changed to an adequate intake, which would impose a limitation on the assessment of iodine intake at population level. Iodine intake is difficult to estimate by means of food consumption surveys. The method of choice for this element is a status study (urinary iodine losses). In the Netherlands, the National Institute for Public Health and the Environment (RIVM) regularly conducts surveys (based on 24-hour urine tests) to monitor changes in the Dutch population's iodine status. The Committee recommends that the average requirement of 100 µg/d be maintained for this application.
- Weakly substantiated adequate intakes have little relevance for the general population because this group does not appear to suffer from deficiencies of this element. The Committee recommends that these dietary reference values should not be used in public information on nutrition or for assessments of the diets of specific groups.

**Table 3.** Relatively strongly substantiated dietary reference values for Dutch adults

| Nutrient | Subgroup | | Dietary reference value | | | Origin |
|---|---|---|---|---|---|---|
| | Men (♂) or women (♀) | Age range | Average requirement | Population reference intake[a] | Adequate intake[a] | |
| Vitamin A[b] | ♂ | | 615 µg/d | 800 µg/d | | this report |
| | ♀ | | 525 µg/d | 680 µg/d | | this report |
| Thiamine[c] | ♂&♀ | | 0.072 mg/MJ | 0.1 mg/MJ | | EFSA |
| Riboflavin | ♂&♀ | | 1.3 mg/d | 1.6 mg/d | | EFSA |
| Niacin[c] | ♂&♀ | | 1.3 mg/MJ | 1.6 mg/MJ | | EFSA |
| Vitamin B6 | ♂ | 18-50 years | 1.1 mg/d | 1.5 mg/d | | GR 2003 |
| | ♂ | >50 years | 1.3 mg/d | 1.8 mg/d | | GR 2003 |
| | ♀ | | 1.1 mg/d | 1.5 mg/d | | GR 2003 |
| Folate[d] | ♂&♀ | | 200 µg/d | 300 µg/d | | GR 2003 |
| Vitamin B12 | ♂&♀ | | 2.0 µg/d | 2.8 µg/d | | GR 2003 |
| Vitamin C | ♂ | | 60 mg/d | 75 mg/d | | NCM 2014 |
| | ♀ | | 50 mg/d | 75 mg/d | | NCM 2014 |
| Vitamin D[e] | ♂&♀ | 18-69 years | | | 10 µg/d | GR 2012 |
| | ♂&♀ | ≥70 years | 10 µg/d | 20 µg/d | | GR 2012 |
| Vitamin K1 | ♂&♀ | | | | 70 µg/d | EFSA |
| Calcium | ♂&♀ | 18-24 years | 860 mg/d | 1000 mg/d | | EFSA |
| | ♂ | 25-69 years | 750 mg/d | 950 mg/d | | EFSA |
| | ♀ | 25-49 years | 750 mg/d | 950 mg/d | | EFSA |
| | ♀ | 50-69 years | | | 1100 mg/d | GR 2000 |
| | ♂&♀ | ≥70 years | | | 1200 mg/d | GR 2000 |
| Iron | ♂ | | 6 mg/d | 11 mg/d | | EFSA |
| | ♀ postmenopausal | | 6 mg/d | 11 mg/d | | EFSA |
| | ♀ premenopausal | | 7 mg/d | 16 mg/d | | EFSA |
| Iodine | ♂&♀ | | | | 150 µg/d | EFSA |
| Potassium | ♂&♀ | | | | 3.5 g/d | EFSA |
| Copper | ♂&♀ | | 0.7 mg/d | 0.9 mg/d | | NCM 2014[f] |
| Magnesium | ♂ | | | | 350 mg/d | EFSA |
| | ♀ | | | | 300 mg/d | EFSA |
| Zinc | ♂ | | 6.4 mg/d | 9 mg/d | | NCM 2014 |
| | ♀ | | 5.7 mg/d | 7 mg/d | | NCM 2014 |

[a] For the relatively strongly substantiated dietary reference values, the population reference intake and adequate intake are equivalent for most applications.

[b] For vitamin A, the dietary reference values are expressed as retinol activity equivalents (RAE): 1 µg RAE = 1 µg retinol = 12 µg β-carotene = 24 µg other carotenoids. These reference values were calculated using the EFSA's method. For the Netherlands, however, the calculations were based on a higher body weight.

[c] The dietary reference values for thiamine and niacin are expressed per megajoule of energy intake. When applied to individuals, energy intake estimates are used to calculate a value in milligrams per day. When formulating diets, the Netherlands Nutrition Centre bases its approach on the energy requirement for an inactive lifestyle. For individuals in the 19 to 50 year age group, that corresponds to approximately 11.5 megajoules (2700 kcal) per day for men and approximately 8.5 megajoules (2000 kcal) per day for women.64 For niacin the reference values are expressed in niacin equivalents (NE): 1 mg NE = 1 mg niacin = 60 mg tryptophan.

[d] For folate, the dietary reference values are expressed in dietary folate equivalents (DFE): 1 µg DFE = 0.6 µg folic acid in fortified foods or folic acid taken with food as a supplement = 0.5 µg folic acid taken on an empty stomach as a supplement. There is a recommendation – concerning dietary supplementation with folate – for women who are trying to become pregnant. It is recommended that, in addition to the dietary reference value, they take a folic acid supplement of 400 µg/day, starting at least four weeks prior to conception and continuing until the eighth week of pregnancy.

[e] For vitamin D, the dietary reference values relate to situations in which there is minimal vitamin D production in the skin. Where there are higher levels of vitamin production in the skin, a lower intake is permissible. For vitamin D there are recommendations concerning dietary supplementation. Adults who do not produce vitamin D in their skin (due to a dark skin tone, or to a lack of exposure of the skin to sunlight) and all women aged 50 to 70 years are advised to take a daily supplement of 10 µg of vitamin D. All individuals aged >70 years are advised to take a daily supplement of 20 µg of vitamin D.

[f] The 2014 NCM dietary reference values for copper correspond to the 2001 IOM DRVs.

**Table 4.** Weakly substantiated adequate intakes for Dutch adults. All these values originate from the EFSA.

| Nutrient | Subgroup | Dietary reference value |
|---|---|---|
| | Men (♂) or women (♀) | Adequate intake |
| Pantothenic acid | ♂&♀ | 5 mg/d |
| Vitamin E | ♂ | 13 µg/d |
| | ♀ | 11 µg/d |
| Biotin | ♂&♀ | 40 µg/d |
| Choline | ♂&♀ | 400 mg/d |
| Phosphorus | ♂&♀ | 550 mg/d |
| Manganese | ♂&♀ | 3 mg/d |
| Molybdenum | ♂&♀ | 65 µg/d |
| Selenium | ♂&♀ | 70 µg/d |

## 4.3 Limitations in available research

The previous chapters have shown that the level of knowledge used to derive dietary reference values has its limitations. As a result, for some substances, it cannot be stated with any certainty whether or not a distinction needs to be made on the basis of gender, weight, or age, for example. For the time being, the new dietary reference values represent the best estimate (best guess) for the various groups, unless group-specific recommendations are available.

For about half of all nutrients, men and women have different dietary reference values (Tables 3 and 4). There is no such distinction with regard to the remaining nutrients. The decisions on whether or not to draw such distinctions are well substantiated for some nutrients[a], but not all. If too little research has been done to determine whether there is a physiological difference in requirement, a single value is established for both men and women[b], or a distinction is made[c]; the distinction may be based on differences in reference weights or average intakes, for example. If a single value is used for both men and women, then women's intake levels are more likely to appear inadequate when compared to men's levels, simply because women eat less than men.

When establishing dietary reference values, the best estimate is made (using available research) of the requirements of healthy individuals with a healthy weight. The background document shows that the focus on people with a healthy weight cannot be strictly applied. Some of the studies from which dietary reference values were derived relate to mixed groups consisting of individuals with a healthy weight and others who are overweight. Some older publications did not provide any information about the participants' body weight or body mass index. In addition, when deriving the dietary reference values, any direct relationship with the reference weights appears to be very limited indeed. Reference weight

[a] For vitamin B6 (older adults), vitamin C, calcium (51 to 70 years age group), iron and zinc, the decision to establish different dietary reference values for men and women has been substantiated. The decision to express the dietary reference values for thiamine and niacin in terms of milligrams per megajoule has been substantiated; the use of this unit implies that the average values in mg/day for men and women are different. For riboflavin, vitamin B6 (younger adults), folate, vitamin D, calcium, iodine, potassium and copper, the decision not to establish different dietary reference values for men and women has been substantiated.

[b] For pantothenic acid, vitamin B12, vitamin K1, biotin, choline, phosphorus, manganese, molybdenum and selenium, there is little, if any, research available that provides a basis for determining whether any physiological differences in requirement exist between men and women. Accordingly, the same value is used for both.

[c] For vitamin A, vitamin E and magnesium, there is little, if any, research available that provides a basis for determining whether any physiological differences in requirement exist between men and women. However, different values are used for each gender.

was directly involved[a] in deriving just two of the dietary reference values (for vitamins A and K1).

For four nutrients, there are scientifically substantiated differences between the dietary reference values for younger and older adults. For vitamin B6 (men), vitamin D and calcium, the dietary reference values for older adults are higher than those for younger adults. For iron (women), the opposite is true. For the other nutrients, the dietary reference values apply to all adults, regardless of their age. For some nutrients, the research available indicates that there is no change in requirement with advancing age[b]. For other nutrients, however, little or nothing is known about the effect of ageing on requirement.

[a] The fact that reference weight plays a direct part in deriving the dietary reference values for vitamins A and K1 does not mean that an individual's requirements can be estimated on the basis of their body weight.

[b] For riboflavin, vitamin B6 (women) and folate, the decision not to establish different dietary reference values for younger and older adults has been substantiated.

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# Committee and working group

**Members of the Committee on Nutrition:**

- Prof. J. Brug, Professor of Health Behaviour and Health Education, University of Amsterdam *(chairperson through August 31th, 2018)*
- Prof. S.J.L. Bakker, Professor of Internal Medicine, University Medical Center Groningen
- Dr. J.W.J. Beulens, Nutritional Scientist/Epidemiologist, VU University Medical Center (VUmc) Amsterdam
- Prof. E. Blaak, Professor of the Physiology of Fat Metabolism, Maastricht University
- Prof. J.M. Geleijnse, Professor of Nutrition and Cardiovascular Diseases, Wageningen University and Research Centre *(member through December 31th, 2017)*
- Prof. J.B. van Goudoever, Professor of Paediatrics, VU University Medical Center and Academic Medical Center (AMC), Amsterdam
- Prof. A.W. Hoes, Professor of Clinical Epidemiology and General Practice, University Medical Center Utrecht
- Prof. M.T.E. Hopman, Professor of Integrative Physiology, Radboud University Medical Center, Nijmegen
- Dr. J.A. Iestra, Nutritional Scientist, University Medical Center Utrecht
- Prof. S. Kremers, Professor of Obesity Prevention, Maastricht University Medical Center
- Prof. R.P. Mensink, Professor of Molecular Nutrition, Maastricht University
- Prof. H. Pijl, Professor of Diabetology, Leiden University Medical Center *(member through December 31th 2016)*
- Prof. J.A. Romijn, Professor of Internal Medicine, Academic Medical Center, Amsterdam *(member through December 31th 2016)*
- Prof. C.D.A. Stehouwer, Professor of Internal Medicine, Maastricht University Medical Center
- Prof. M. Visser, Professor of Healthy Ageing, Vrije University Amsterdam and VU University Medical Centre, Amsterdam
- Prof. M.H. Zwietering, Professor of Food Microbiology, Wageningen University and Research Centre, Wageningen
- Dr. H. Van den Berg, biochemist-nutritionist, retired, Zeist *(structurally consulted expert)*

**Observers:**

- Dr. C.T.M. van Rossum, National Institute for Public Health and the Environment (RIVM), Bilthoven
- Ir. B.H. Smale, Ministry of Health, Welfare and Sport, The Hague

**Scientific secretaries:**

- Dr. K.G. van der Mark-Reeuwijk, Health Council, The Hague
- Drs.E.J. Schoten, Health Council, The Hague
- Dr. C.J.K. Spaaij, Health Council, The Hague
- Dr. R.M. Weggemans, Health Council, The Hague

**Members of the Working group on Dietary reference values:**

- Prof. J. Brug, Professor of Health Behaviour and Health Education, University of Amsterdam *(chairperson through August 31th, 2018)*
- Prof. S.J.L. Bakker, Professor of Internal Medicine, University Medical Center Groningen
- Dr. H. Van den Berg, biochemist-nutritionist, retired, Zeist
- Dr. J.W.J. Beulens, Nutritional Scientist/Epidemiologist, VU University Medical Center (VUmc) Amsterdam
- Prof. E. Blaak, Professor of the Physiology of Fat Metabolism, Maastricht University
- Prof. J.M. Geleijnse, Professor of Nutrition and Cardiovascular Diseases, Wageningen University and Research Centre *(member through December 31th, 2017)*
- Prof. J.B. van Goudoever, Professor of Paediatrics, VU University Medical Center and Academic Medical Center (AMC), Amsterdam
- Dr. J.A. Iestra, Nutritional Scientist, University Medical Center Utrecht
- Prof. R.P. Mensink, Professor of Molecular Nutrition, Maastricht University
- Prof. M. Visser, Professor of Healthy Ageing, Vrije University Amsterdam and VU University Medical Centre, Amsterdam

**Observer:**

- Dr. C.T.M. van Rossum, National Institute for Public Health and the Environment (RIVM), Bilthoven

**Scientific secretaries:**

- Dr. C.J.K. Spaaij, Health Council, The Hague
- Dr. S.R. Vink, Health Council, The Hague

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