Deriving and applying average requirements and population reference intakes or adequate intake levels in adults

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Background document to:
Dietary reference values for vitamins and minerals for pregnant women
2021/27, The Hague, 22 June 2021

Health Council of the Netherlands

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01 introduction

This background document gives background information about how dietary reference values are derived. The dietary reference values give information about the intake levels that the body needs to function properly or avoid diseases, as well as about the highest intake levels that are still thought to be safe.[1,2]

There are four types of dietary reference values:

1. the average requirement,
2. the population reference intake,
3. the adequate intake and
4. the tolerable upper intake level.

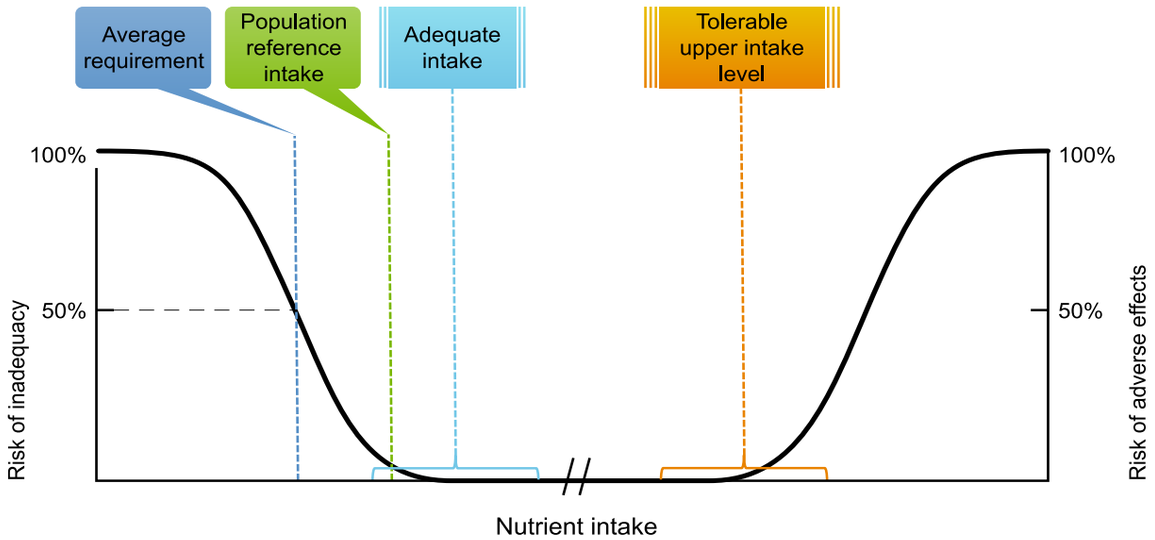

Figure 1 The types of dietary reference values in relation to nutrient intake (x-axis) and the probability that this intake is too low or too high (y-axis).

Types of dietary reference values

There are different types of dietary reference values:

1. The *average requirement* refers to the intake level that would meet the personal requirements of half of all people, but not those of the other half.
2. The *population reference intake* is the level considered sufficient for almost everyone in the population group in question. This level can only be determined if sufficient scientific research data have been found to estimate an average requirement. In theory, the population reference intake is the intake level that is adequate for exactly 97.5% of the relevant group. However, due to uncertainties in the research on which average requirements and population reference intakes are based, it is better to use the phrase ‘almost everyone in the population group in question’.
3. *Adequate intake* is an intake level that can be assumed to meet the requirements of almost everyone in the population group in question. This type of dietary reference value is determined if the average requirement and, as a result, the population reference intake as well, cannot be determined.
4. The *tolerable upper intake level* is the highest intake level at which no harmful overdosage effects are to be expected to result from long-term exposure.

The tolerable upper intake level is not the ideal intake level. This is because an increase in intake above the population reference intake or adequate intake is not expected to provide further health gains, and a higher intake than the tolerable upper intake level is potentially unhealthy.

02 establishing the average requirement or adequate intake

Various methods are available for deriving the average requirement or the adequate intake level.

Risk of deficiencies

Causing symptoms of deficiency in humans is not ethically acceptable. Data about the intake levels at which symptoms of deficiency occur is therefore scarce. Dietary reference values are consequently not usually based on that type of data. It is assumed that dietary reference values derived through the approaches below are more than sufficient to prevent deficiencies.

Risk of chronic diseases

There is convincing evidence for some nutrients that intake levels affect the risk of developing certain chronic diseases. Such data may be about the occurrence of the disease itself or alternatively about the level of 'intermediate endpoints' that are deemed very likely to influence the occurrence of these diseases. Dietary reference values are also established based on such data. When dietary reference values are based on the risk of chronic diseases, usually an adequate intake is derived rather than a population reference intake.

Biochemical parameters of the nutritional status

For some biochemical parameters, attaining or not attaining a certain threshold value of the parameter is an indicator for excessively low intake of a nutrient. In that case, the relationship between the nutrient intake and the particular biochemical variable can be used to estimate the average requirement or adequate intake. The average intake level at which the biochemical variable reaches the threshold value is the average requirement.

If there is insufficient data available to determine this intake level, the level of intake above which the biochemical variable reaches a value above the threshold in almost all people is determined and referred to as the 'adequate intake'.

Biochemical parameters for the nutritional status can be split into two main groups:

1. The concentration of the nutrient concerned in various compartments of the body.
2. Functional parameters that are indicators of nutrient's activity at the cellular level or in a physiological system. If the nutrient functions in an active form as a coenzyme or cosubstrate of an enzyme, the activity of that enzyme or the amount of the holoenzyme can be a functional parameter of the nutritional status. Intermediate metabolic products can also be used as functional parameters of nutritional status.

For some nutrients, there are various biochemical variables that can characterise the nutritional status. The choice of these variables is also a determining factor for the dietary reference values. The choice is driven by expectations in terms of health gains.

Factorial method

The factorial method involves adding up the individual factors that determine the requirement (Figure 2). These are the amounts of the nutrient leaving the body through the faeces, urine and skin and (if applicable) the quantities required for growth, pregnancy or lactation. The extra requirement during growth and in pregnancy is the amount of nutrient stored in the newly formed tissues; this also known as 'retention'. The extra requirement during lactation is the amount of nutrient secreted by the body in the breast milk.

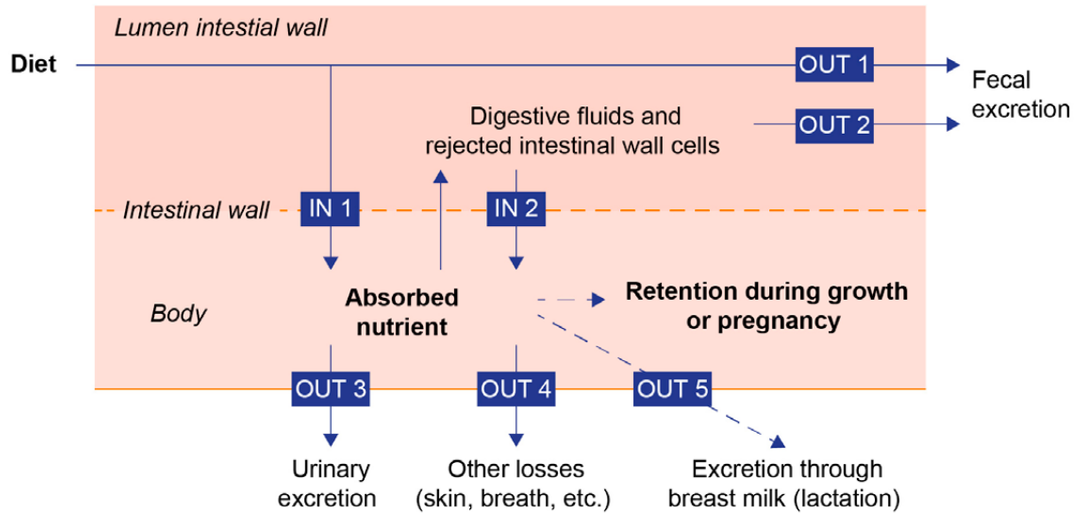

Figure 2 Estimating the average requirement by the factorial method.

The apparent absorption percentage is the difference between the intake level and faecal excretion divided by the intake. This is an underestimate of the fraction actually absorbed as nutrients in the faeces come not only from the diet but also from digestive juices and intestinal wall cells that have been shed. Techniques using isotopes have made it possible to also determine the actual absorption percentage. Data of this type is preferable to estimates of apparent absorption but is not always available.

Determining the average intake level

For some nutrients, there is insufficient knowledge to derive dietary reference values for adults using any of the methods above. If no symptoms of deficiency are reported for micronutrients in the Netherlands, the adequate intake for adults is set at the level of the average intake.

03 application of dietary reference values

The dietary reference values have a wide range of applications.

- The Netherlands Nutrition Centre bases its public education on nutrition, including the Wheel of Five and examples of healthy daily diets, on both the *Dutch dietary guidelines 2015* and the dietary reference values (population reference intakes and adequate intakes).
- 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 intake levels of the Dutch population. For this application, the average requirement and population reference intake are more appropriate than the adequate intake. If high-risk groups are identified based on the dietary reference values, confirmation is needed that is based on research into nutritional status (e.g. certain blood values) or on the prevalence of clinical symptoms.
- Healthcare professionals such as dieticians and doctors use the dietary reference values (the population reference intakes and the adequate intakes) to advise individuals about healthy eating habits or diets.
- Dietary reference values are valuable in situations where food is rationed, such as in emergency aid or military exercises.
- Dietary reference values play a role in regulations on fortification of foods and the composition of supplements.
- Dietary reference values are used in the product composition information on food labels.

The dietary reference values for some nutrients are only weakly substantiated. Those reference values are not very relevant to the general population as deficiencies of them do not seem to occur. In its advisory report called *Dietary reference values for vitamins and minerals for adults*, the Committee advised that a specific set of weakly substantiated dietary reference values should not be used for public information on nutrition and the diets of specific groups.[3] Weakly substantiated dietary reference values can however be valuable in situations where food is rationed and where there is not a varied dietary pattern.

literature

1 Gezondheidsraad. *Voedingsnormen: vitamine B6, foliumzuur en vitamine B12.* Den Haag, 2003; publicatienr. 2003/04.

2 The Health Council of the Netherlands. *An evaluation of the EFSA's dietary reference values (DRVs), Part 1, Dietary reference values for vitamins and minerals for adults.* The Hague, 2018; publication no. 2018/19A.

3 The Health Council of the Netherlands. *Dietary reference values for vitamins and minerals for adults.* The Hague, 2018; publication no. 2018/19E.

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