Commission of the European Communities

food — science and techniques

Reports of the Scientific Committee for Food

(Thirty-first series)

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Nutrient and energy intakes for the European Community

(Opinion expressed on 11 December 1992)

Directorate-General
Industry

1993

Published by the
COMMISSION OF THE EUROPEAN COMMUNITIES
Directorate-General
Telecommunications, Information Industries and Innovation
L-2920 Luxembourg

Cataloguing data can be found at the end of this publication

Luxembourg: Office for Official Publications of the European Communities, 1993

ISBN 92-826-6409-0

Printed in Belgium

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For their valuable and kind assistance with this study, the Scientific Committee for Food wishes to thank:

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1. Introduction

Mandate

To advise on the establishment of European Recommended Dietary Allowances for a number of purposes, including nutrition labelling and Community programmes on research and nutrition, and to make recommendations.

Policy of the Committee

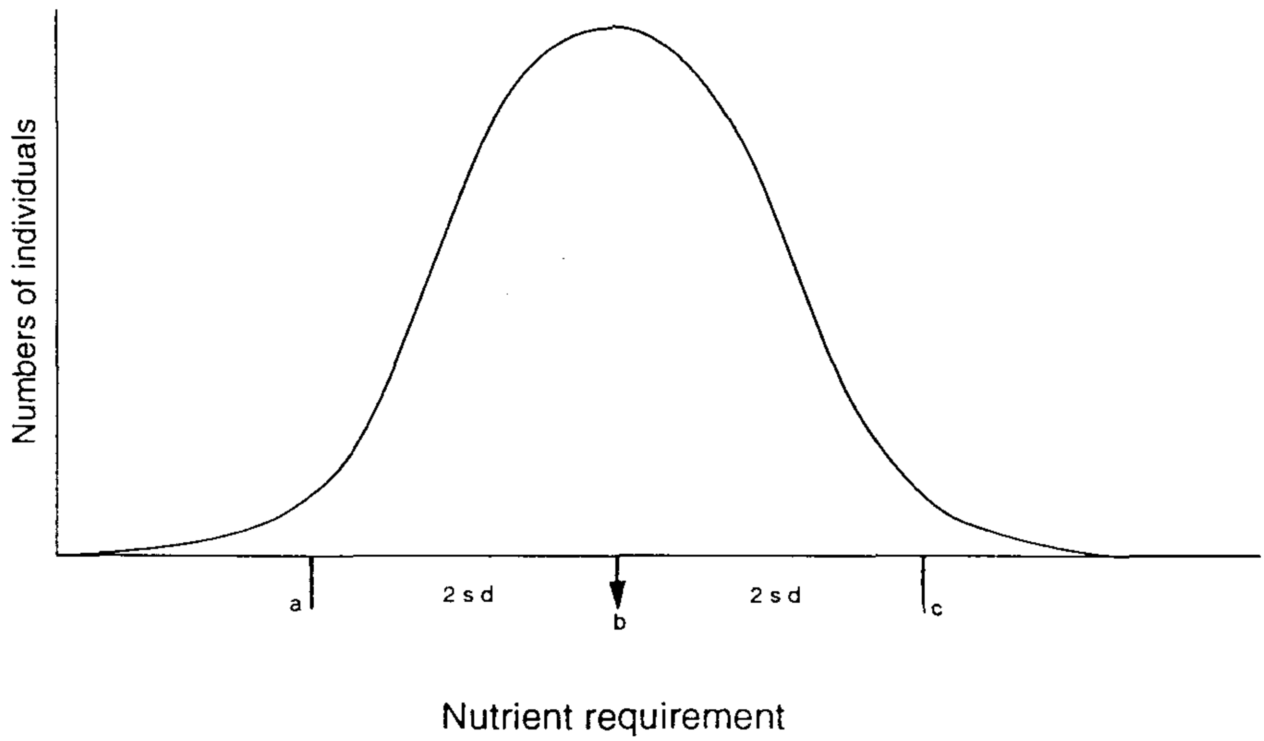
Almost all countries of the European Community have independently convened committees of experts to derive values for nutritional recommendations. These experts, drawing from a common pool of data, have used physiological and biochemical knowledge to estimate nutrient requirements. In many cases the data are limited and the expert committees have had to make decisions on the balance of evidence.

For most nutrients the derived requirements are fairly similar across the Community [1]. Not surprisingly, however, committees can assess the evidence from slightly divergent viewpoints and arrive at different values for nutrient requirements. This can raise problems for food manufacturers, food regulators and consumers. The Committee set up a working group, representative of various views on the interpretation of the available evidence, to compile a set of recommendations that could be used across the Community for a variety of purposes.

The working group consisted of 19 experts who operated in four sub-groups covering (i) energy and protein, (ii) water-soluble vitamins, (iii) fat-soluble vitamins, and (iv) minerals and trace elements. The sub-groups met several times, and the full working group met on seven occasions.

The Committee debated at length how to present their recommendations in the most helpful way. Their decisions are described in the section below on Recommendations and Nomenclature. The Committee drew on the experience of a number of expert committees, of member countries, of non-member countries [2,3], and of international agencies [4,5]. They did not, however, just try to harmonise existing national reports of member states, but sought instead to consider the data afresh, including the most recent, and sometimes still unpublished, work.

Fig 1.1 The frequency distribution of individual requirements for a nutrient



Point **b** is the mean requirement of the group. Point **c** (mean + 2 SD) is the intake that will meet the needs of nearly all healthy people in a group. Point **a** (mean - 2 SD) is the intake below which nearly all individuals will be unable to maintain metabolic integrity according to the criterion chosen.

In this report, point **b** will be called the **Average Requirement (AR)**. Points **c** and **a** will roughly correspond to the **Population Reference Intake (PRI)** and the **Lowest Threshold Intake (LTI)** respectively.

Recommendations and nomenclature

Many countries in the world have produced quantitative dietary recommendations under a variety of names such as recommended daily amounts, recommended daily allowances, recommended daily intakes, recommended dietary intakes and recommended nutrient intakes, among others. In this report they will be referred to by the generic term RDA.

A major problem in formulating a RDA is that nutrient requirements differ between individuals. They are conventionally assumed to have a normal Gaussian distribution, as depicted in Figure 1.1, with a peak at the mean requirement (point b in Fig. 1.1). Experimental evidence supporting this for humans is scanty, and a clear exception is known in the iron requirements of menstruating women, which are skewed, with a long tail of higher values. Nevertheless the basic assumption serves as a useful concept on which to base discussions of variations between individuals.

The policy adopted for most nutrients over many years by bodies promulgating RDAs was to choose a single value at, or more likely beyond, the top end of the distribution range, i.e. to give an intake that would cover the needs of all or almost all members of the group. Notionally this is often described as the mean requirement of the group plus two standard deviations (SD), i.e. covering at least 97.5 % of the population (point c in Fig. 1.1).

This approach had great merits for the original use of RDAs – to set a standard for an adequate diet for groups of the population; it is simple, and one can check by observation if the RDA has been set high enough. A single value RDA however is often misinterpreted or misused; it is sometimes regarded as the lowest acceptable intake, despite being clearly defined as substantially more than individual needs for the great majority of the population.

The more recent extensions of the use of RDAs to other purposes highlight the shortcomings of the single RDA. Reviewing bodies are therefore tending to move away from single RDA values. Agreeing with that view, this Committee is attempting to give, as far as possible, three values to indicate the spread of needs, corresponding to points c, b and a in Figure 1.1.

Point c, that intake which will meet the needs of virtually all healthy people in a group, corresponds conceptually with the traditional RDA. Since the Committee is producing more than one value, it seems inappropriate to retain a term such as recommended dietary allowance for this value alone. The use of the adjective 'recommended' has been criticised as potentially misleading, for intakes can be recommended only on a basis of probability. Even though always clearly stated, this is not always recognised by users, perhaps because of the prescriptive overtones of 'recommended', and reviewing bodies have been introducing other terms. This Committee will call the intake that is enough for virtually all healthy people in a group the **Population Reference Intake (PRI)**.

Point b in Figure 1.1 is the **Average Requirement (AR)** for the group, according to the criterion chosen.

Point a in Figure 1.1 is the intake below which, on the basis of our current knowledge, almost all individuals will be unlikely to maintain metabolic integrity according to the criterion chosen for each nutrient. The Committee will call this the **Lowest Threshold Intake (LTI)**.

As mentioned previously, the schematic Figure 1.1 represents a conceptual framework, which may be adjusted to deal with the information available on specific nutrients. For example, the PRI is set notionally as the mean requirement plus two standard deviations, and thus about 2.5 % of the population would be inadequately supplied by that intake. In practice, this is not so; the mean and the standard deviation cannot be established reliably, and it is common to incorporate a safety factor by fixing the PRI at the lowest level above which all subjects appear to be adequately supplied.

In the absence of more reliable information, the LTI values in this report have been calculated as the mean minus two standard deviations. If more direct evidence is available to provide other figures, this has been used. Because deficiencies of most nutrients are fortunately relatively rare, data from which to estimate the LTI are often very inadequate, and the criteria chosen as indicators of deficiency may vary somewhat in stringency. In this report LTIs are often set on the prudent side, being not those intakes below which frank deficiency is almost certain, but rather those intakes below which there may be cause for concern for a substantial section of the population.

Consequently, the PRI and LTI values are not always the means plus and minus two standard deviations. Furthermore, there is much uncertainty about what the standard deviation should be. Many biological characteristics have a coefficient of variation of 15 %, and this is often assumed in this report. Nevertheless for some nutrients other coefficients of variation have been used, because there is direct evidence to that effect, or to allow a larger safety factor, or where the calculated values fit uneasily with observations.

The Committee has given only one value for increases during pregnancy or lactation; it considers it has inadequate information to give more with any confidence.

For nutrients where the requirements are given in terms of energy intake, there is the problem of how to give meaningful PRIs and LTIs as a weight of nutrient per day. The convention adopted in this report is to give the PRIs and LTIs for average energy intakes.

Use of values proposed

Multiple values are of greater utility than just a single RDA. For any particular use, one or other of the values may be appropriate:

Assessing the diets of individuals

Any individual who habitually has an intake equal to or greater than the PRI will almost certainly be provided for adequately. As the habitual intake falls below the PRI towards the LTI, the chances of being inadequately provided for increase. If the habitual intake falls below the LTI, further investigation of the nutritional status of the individuals being studied may need to be carried out.

Considerable caution should be exercised in judging an individual's diet in this way. Measurements of habitual intake of a nutrient are often not very accurate and the proposed reference values in this report are subject to some uncertainties.

Assessing the diets of groups

The risk of deficiency in a group can be estimated from the numbers and the intakes of those in the group habitually consuming less than the PRI. As the number of individuals with intakes below the PRI increases, so does the likelihood of the group being inadequately provided for.

For prescribing diets or provisions of food supplies

When diets are being devised or food supplied, they should contain nutrients at the level of the PRI (and adequate energy), over a period of time, to ensure negligible risk of deficiency in any person. Most individuals would therefore receive in excess or well in excess of their nutrient needs.

For food labelling purposes

This is discussed in detail in chapter 36 of this report.

Energy recommendations

The above considerations cannot apply to recommendations for energy. PRIs for other nutrients are set at the top end of the distribution of requirements to eliminate any cases of deficiency. The fact that most people will consume more than they need is of relatively little importance and will do no harm. That is not true for energy intakes. These are therefore given as average requirements for a group; they cannot be used for individuals, but are important for catering and food supply programmes.

Acceptable ranges of intakes

For some nutrients known to be essential, the data are inadequate for making recommendations. For these nutrients, an acceptable range of intakes is given, based on observations that individual consumptions within these limits appears satisfactory in that neither deficiency nor signs of excess are seen.

High levels of nutrient intakes

Most individuals aim at a nutrient intake that is not less than the PRI. Many habitually consume more. This may be due to the composition of the customary diet (e.g. a high consumption of meat may lead to a diet rich in protein; a high consumption of fruit and vegetables may produce a diet rich in folate), or to the deliberate consumption of some nutrient-rich foods (e.g. consumption of liver leading to a high intake of iron and vitamin A). Nutrient intakes may also be high due to consumption of dietary supplements or fortified foodstuffs.

Intentional consumption of nutrients considerably above the PRI is not uncommon. This is in part due to the well-publicised claims which have been made that some nutrients have extra health benefits at intakes very much higher than those needed to prevent recognised deficiency signs [6]. The Committee considers the evidence insufficient at present to justify making quantitative recommendations in this regard, but the results of current research are awaited with interest. For most nutrients however, there is little reason to expect any advantage from intakes that are greatly in excess of the PRI.

For most nutrients, the PRI can be exceeded several fold without causing adverse effects and although any additional benefits are unlikely, there is no harm in individuals consuming amounts of these nutrients that are much higher than the PRI.

For some nutrients however, undesirable effects can occur at levels relatively close to the PRI. In some cases, there may be consequences that are not directly harmful, but are undesirable – for example, high intakes of folate may have the effect of masking the effects of vitamin B_{12} deficiency, thus preventing its diagnosis early enough to avoid damage to the nervous system. In a few cases, high amounts of a nutrient are toxic, notably vitamin A after persistent intakes of a little over ten times the PRI. High intakes of these nutrients are likely to cause undesirable effects and should not therefore be encouraged.

This report gives for individual nutrients levels above which there is concern about undesirable or harmful effects. Where there is no hard evidence of adverse effects, then indications are given of intakes that have been reported as producing no apparent adverse effects. However while for many nutrients there is no reason to believe that intakes well above the PRI will be harmful, the Committee counsels caution; for example, vitamin B_6 was thought for a long time to be non-toxic, but recent evidence suggests that intakes above 50 mg per day are potentially toxic.

Age groups reviewed

The main emphasis of this report is placed on values for adults, as the quality of the data on which decisions have to be based is higher than for other groups of the population.

The report deals also with the requirements of children down to six months. For most nutrients the requirements of infants below that age were not considered, as they would be either breast- or formula- fed. The composition of infant formulas is a complex matter raising problems of bioavailability etc. that are better dealt with by a more specialist expert group.

Only for energy and protein have values been given for infants below the age of six months. It seems reasonable to do this because they are based on more solid calculations than are values for other nutrients, they can be calculated for narrower age groups, and the information should be of value for many purposes.

For most nutrients, children have been divided arbitrarily into age groups: 6-11 months, 1-3 years, 4-6 years and 7-10 years. From 11 years onwards, the sexes have been divided into age groups of 11-14 years and 15-17 years. (The convention being used in this report is that, for example, the 1-3 year group covers children from their first birthday to the day before their fourth birthday).

Individuals aged 18 years or more are considered as adults. Adults are broken down further into age groups only for consideration of energy requirements.

Children

Experimental data on the nutrient needs of children are more sparse and in general less reliable than for adults. The Committee considers that information is inadequate to give Average Requirements or Lowest Threshold Intakes for children and is limiting itself to giving Population Reference Intakes. For most nutrients the experimental data are frequently insufficient even for that restricted purpose. Most committees have tackled the problem by interpolating between the values for young adults and those for infants, based on the composition of breast milk. Some committees have based recommendations, usually for minerals, on calculations and assumptions using factorial approaches based on tissue composition, basal losses and the changing size of body compartments.

In this report, where no specific statement has been made, the PRIs for children of one year and over have been derived, in the absence of reliable data, by extrapolation from the PRI of young adults on the basis of energy expenditure. The energy expenditure of a growing child includes the energy cost of growth and the increase in body mass, as well as basal metabolic rate and physical activity. It thus appears to provide a basis on which to estimate the requirement for other nutrients above the maintenance level. For infants 6-11 months, the values are usually derived by interpolation between those known for infants below 6 months, and those calculated for the 1-3 years group.

The PRIs given for children are therefore best estimates, but they are similar to values proposed by committees in a number of countries. They should perhaps be regarded as serviceable values for food labelling and planning purposes, rather than definite statements of need.

The elderly

Because of demographic developments in Europe, more attention now has to be paid to the nutrition of the elderly.

With increasing age, there is usually progressive loss of lean tissue, energy needs tend to decline, and energy intake to fall. The deficiency of some nutrients, seen not infrequently, can arise from a greatly reduced food intake in the elderly. It is desirable for the elderly to remain active and to keep up their intake with foods of a high nutrient density.

Dietary deficiencies can also occur because of the inability of some old people to care properly for themselves, or because of illness which is the primary cause of malnutrition.

There is no evidence that the nutrient requirements (as distinct from the energy requirements) of the elderly differ from those of middle-aged adults, and except for vitamin D, no different values are given.

Bioavailability

Dietary nutrients have to be absorbed and utilised by the body to exert their physiological effect. The extent to which this occurs is referred to as the bioavailability of the nutrient, usually expressed as a percentage.

For some nutrients the bioavailability is high and does not raise a problem. For others the bioavailability is much lower, and this has been allowed for when making recommendations.

Many factors affect the bioavailability of a nutrient. It may be the chemical form in which it occurs in the diet, for example, folate in the monoglutamate and polyglutamate forms, haem iron and inorganic iron. There may be interactions with other dietary constituents which reduce (or enhance) bioavailability.

The absorptive capacity of the intestine may be limited and may be influenced by systemic factors. It may be dependent on the need for the nutrient in the body; adaptation can occur to change bioavailability.

Because of the many factors influencing it, the bioavailability of a nutrient may vary substantially with circumstances, and it is often poorly predictable. No single value can be given with any reliability, yet in drawing up recommendations it is usually necessary to select one. Some compromise has to be arrived at, usually based on common dietary patterns. The problems are discussed in more detail in the sections on the nutrients where they raise difficulties, notably among the minerals and some of the vitamins.

General considerations

The recommendations are expressed per person per day. This does not mean that those amounts should be taken every day; conceptually they represent the average intake over a period of time.

The values are proposed for groups of healthy people, and may not apply to those with different needs arising from disease, medication or adherence to a special diet.

The values put forward for any one nutrient assume that the requirements for energy and all other nutrients are met.

Research needs

The Committee is acutely aware that there are many gaps in the data it had to use to produce the variety of values presented in this report. Some are mentioned specifically in sections dealing with individual nutrients; others are implicit in that some decisions clearly have had to be made on the basis of inadequate evidence. In the Committee's view this unsatisfactory situation is in part a consequence of the limited amount of nutritional research that has been carried out in the Community and in the world at large. The nutritional needs of the normal healthy individual are commonly classified as a low priority for medical research.

The Committee recommends that the EC reconsider the importance of research on the nutritional needs of the European consumer, to provide more reliable information to serve as the basis for better advice across the wide variety of dietary patterns in Europe.

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