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ORIGINAL ARTICLE

European micronutrient recommendations aligned: a general framework developed by EURRECA

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Background: In Europe, micronutrient recommendations have been established by (inter)national committees of experts and are used by public health-policy decision makers to monitor and assess the adequacy of the diets of population groups. Current micronutrient recommendations are, however, heterogeneous, whereas the scientific basis for this is not obvious. Alignment of setting micronutrient recommendations is necessary to improve the transparency of the process, the objectivity and reliability of recommendations that are derived by diverse regional and (inter)national bodies.
Objective: This call for alignment of micronutrient recommendations is a direct result of the current sociopolitical climate in Europe and uncovers the need for an institutional architecture. There is a need for evidence-based policy making, transparent decision making, stakeholder involvement and alignment of policies across Europe.
Results: In this paper, we propose a General Framework that describes the process leading from assessing nutritional requirements to policy applications, based on evidence from science, stakeholder interests and the sociopolitical context. The framework envisions the derivation of nutrient recommendations as scientific methodology, embedded in a policy-making process that also includes consumer issues, and acknowledges the influences of the wider sociopolitical context by distinguishing the principal components of the framework: (a) defining the nutrient requirements for health, (b) setting nutrient recommendations, (c) policy options and (d) policy applications.
Conclusion: The General Framework can serve as a basis for a systematic and transparent approach to the development and review of micronutrient requirements in Europe, as well as the decision making of scientific advisory bodies, policy makers and stakeholders involved in this process of assessing, developing and translating these recommendations into public health nutrition policy.
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Variability, alignment and the policy context in the process of micronutrient recommendations development

The aim of nutritional recommendations is to provide guidelines for the nutrient composition of diets as a basis of good health and quality of life. Micronutrient recommendations can be used to provide advice to public health policy makers as a tool to monitor and assess the adequacy of the diets of population groups. With this information, diet-related policies can be developed (Pavlovic *et al.*, 2007). The purpose of micronutrient recommendations is to provide guidelines for the nutrient composition of diets as a basis of good health and quality of life for populations; they are based on judgments built on the knowledge base of micronutrient requirements in a particular population.

Currently, most countries in Europe establish their own nutrient recommendations, which has resulted in a large heterogeneity (that is, variation) in recommendations within Europe (King and Garza, 2007; Prentice *et al.*, 2004; Doets *et al.*, 2008). The heterogeneity in nutrient recommendations is in part due to the use of different approaches (for example, health outcomes and methods used when data are missing for sub-populations), changes in the approach

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to establish nutrient recommendations in time and/or different data underlying them (Hautvast *et al*., 1989; Doets *et al*., 2008). The persistence of different terminologies for essentially the same nutritional concepts relevant to recommendations confuses discussions on micronutrient recommendations and illustrates the difficulty of translating science into policy within the European sociopolitical context. It can be deducted from the different (inter)national micronutrient recommendations that the terminology of micronutrient recommendations differs throughout Europe and other (inter)national bodies and organs (Doets *et al*., 2008). The survey we conducted further illustrates that terminology is indeed heterogeneous and that the process of setting micronutrient recommendations has not always been transparent (see Box 1; Table 1; Figure 1).

Although a transparent terminology or common language is a first step, the different terms refer largely to the same concepts. Variability in recommendations originates from the differently selected scientific evidence and from the variation in the interpretation of this evidence. The background information provided in recommendation reports often lacks transparency, as it is not possible to disentangle the relative contribution of different aspects of scientific evidence. This lack of transparency leads to perceived inconsistency, perceived lack of objectivity, complexity in presentation, lack of clarity, difficulty in implementation, decreased chances of reliability and hidden research gaps (Garza and Pelletier, 2007). Variability is also detected in the way micronutrient recommendations are applied to policy in different countries.

Clearly, because of the heterogeneity in micronutrient recommendations in Europe, an overall view on the scientific perspective is needed to guide expert committees by providing standardized and transparent scientific approaches. This perspective will help to align (the scientific underpinning of) micronutrient requirements contributing to transparency of the process, and the objectivity and reliability of the recommendations that are derived by diverse regional and (inter)national groups. This will result in a common basis for groups of experts developing micronutrient recommendations, and for setting objectives for national policies such as fortification programmes and for addressing regulatory and trade issues (King and Garza, 2007).

Scientific alignment includes the scientific content (objectivity, transparency, common basis), processes to collate and summarize evidence, and application of results by regional, national and international users who evaluate their policy options and implement the chosen applications.

The call for alignment of micronutrient recommendations is a direct result of the current sociopolitical climate in Europe characterized by a need for an institutional architecture that is seen to be both legitimate and effective, the recognition of the greater willingness and need for the inclusion of wider sections of society, and the call for more rational decision making. To achieve this, a series of policy documents have emphasized the following core aspects of policy making:

(a) *Evidence-based policy making*: There is a growing emphasis on evidence-based policy making at all levels of

Box 1 Heterogeneity and the need for standardization—an example from a cross-European study

To acknowledge the European diversity and to illustrate the need for standardization we conducted a survey in 35 European countries and we collated background documents from 11 European countries, the WHO/FAO and EC. EURRECA-partners and country-specific key informants or experts assisted throughout the whole process of data collection.

Concerning the origin of micronutrient recommendations, 12 European countries, the WHO/FAO and EC went through the process of setting their own recommendations. The remaining countries (partly) adopted their micronutrient recommendations from other countries/organizations.

The final responsibility for setting micronutrient recommendations rests with the government. In most countries the recommendations are supported by one or a combination of scientific bodies in which at least three of the following fields of expertise were involved: nutrition, (public) health, medicine, biochemistry, food technology, epidemiology, food hygiene and toxicology (Timotijevic *et al*., 2010 (this issue)).

Different sets of terminology are currently used for the total set of nutrient recommendations (DRIs, DRVs, RDAs and so on) by the different European countries. Within these sets, different terms have been used to express the levels of requirement and the certainty with which they have been set. However, almost all different terminologies could be recognized as equivalents of the concepts behind the terminology that was put forward by United Nations University (King and Garza, 2007). Though the terminology differed substantially between countries, it could be subsumed under a few basic concepts as summarized in the first two columns of Table 1.

The (number of) age groups defined in the micronutrient recommendation tables differed largely between countries, for example, the cutoff point for elderly people ranged between $\geqslant$50 and $\geqslant$76 years. Furthermore, the countries defined adequacy most often as 'the prevention of deficiency diseases'; although 10 countries referred to the more vague term of optimal health. End points and approaches that are used by countries as a basis for recommendations varied essentially between population groups. Also the types of evidence that countries used varied; countries used (combinations of) one to five different types of evidence, including epidemiological studies (intervention trials and/or observational studies) and/or expertise of a national or international expert committee. The heterogeneity of the evidence-base is visualized in Figure 1.

Once (single) micronutrient recommendations are set, it still remains a big step before policy options and applications can be materialized. Nevertheless, from our survey it became clear that in most European countries policy options have been formulated for several nutrients such as iodine, sodium, iron, vitamin D and folate. Moreover, from single nutrient policies to recommendations for the diet as a whole is a scientific challenge in itself as such policies also tend to be influenced by socio-cultural and economic issues, for example, the food patterns of subpopulations and the agrifood sector in the countries. 'General health education' and 'Food-based dietary guidelines' (FBDG) were the most frequently mentioned policy applications. FBDG were presented in the shape of a pyramid or plate/circle in most countries.

Table 1 Common terminology proposed by UNU and currently used terminology

UNU term	*UNU definition (King and Garza, 2007)*	*Terminology used by European countries/organizations and key non-European countries for equivalent concepts*
NIV	Nutrient intake value encompasses the set of recommendations.	Dietary reference intakes (US) – Reference values for nutrient intake (DACH[a]) – Dietary reference values (UK, France)
ANR	The Average Nutrient Requirement is the average or median requirement estimated from a statistical distribution of required intakes for a specific criterion (such as a biomarker or health indicator) and for a particular age- and sex-specific group.	Estimated average requirement
INLx	The Individual Nutrient Level is the recommended nutrient level for all healthy individuals in a specific sub-population. The x covers the needs of a certain % of the population.	– Recommended nutrient intake (DACH, UK, WHO) – Population reference intake (France, EC) – Recommended average (Latvia) – Recommended daily allowance (The Netherlands, US) – Recommended intake (Nordics) =all equal to $INL_{97.5}$
Other general terms and definitions		
AI[b]	The Adequate Intake is defined as the observed or experimentally derived intake in a defined population group that appears to sustain health. It is used when there are insufficient data to establish a statistical distribution of individual requirements and, therefore, an ANR and INLx.	– Estimated value for adequate intake (DACH) – Adequate intake (France, Netherlands, EC, US) – Safe intake (UK) – Acceptable Intake (WHO)
Acceptable range	The acceptable range is a range of safe intake values and is given where insufficient information is available.	– Acceptable range (EC) – Estimated value for adequate intake (DACH) – Adequate area of intake (Netherlands) – Safe intake (UK)

[a]DACH stands for the German-speaking countries: Germany, Austria and Switzerland.
[b]From a scientific point of view, this term is not advocated, as it is a default approach that should be used only if too little information is available for the ANR and/or INLx.

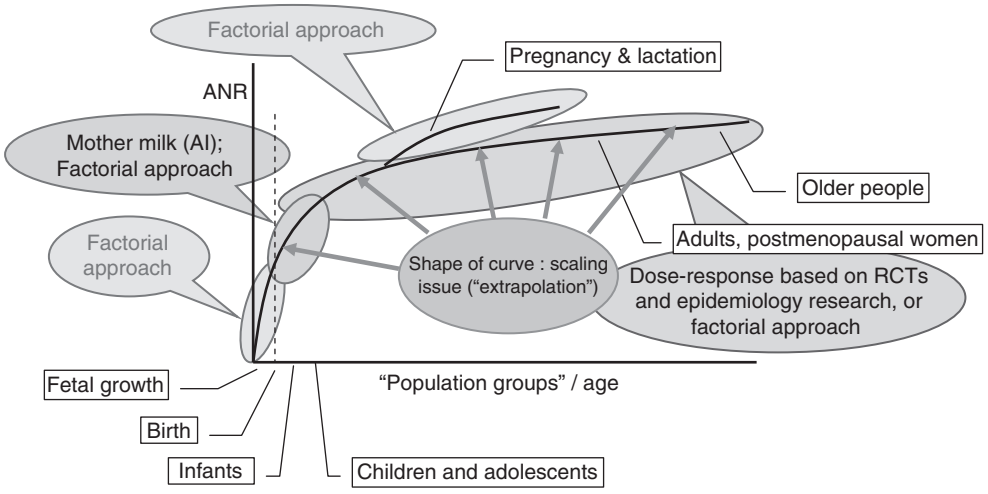

Figure 1 The evidence base for micronutrient recommendations is heterogeneous by population groups. This figure conceptualizes the ANR (Average Nutrient Requirement) as a function of population group and age (fetus to elderly), and illustrates the different research approaches and types of evidence underlying this function. Factorial approaches, combined with estimates of bioavailability, are traditionally used during periods of growth, that is, during the early stages of life, pregnancy and lactation, and during more stable periods of adult life; randomized controlled trials and epidemiological studies provide evidence for optimal nutrition as related to specific health conditions and end points. To arrive at consistent recommendations, these data need to be transparently integrated while accounting for scaling, because of body size, body composition and physical activity. The required alignment of methodologies will go hand in hand with the identification of research needs.

governance. It is thought that this would, on one hand, improve the quality of the decision-making outcomes, and, on the other hand, lead to greater acceptance of these decisions as it will provide policy makers with a means of accountability and enable greater clarity about the bases of these decisions.

(b) *Transparency*: Various policy documents (European Commission, 2000, 2001; EFSA, 2009) have indicated a

need for greater transparency of the workings of expert advisory bodies, and the way in which evidence is collated and conclusions drawn and communicated to and used by policy makers, as well as openness to a range of perspectives, including lay.

(c) *Stakeholder involvement*: There is public policy imperative and drive for democratic renewal of public and stakeholder engagement in policy decisions at all levels of national and European Commission governance (European Commission, 2001, 2002, 2006). In relation to micronutrient recommendations, it is now clear that these must be usable and must respond to the needs of those who will be its ultimate users, such as industry, public health practitioners and consumers.

With respect to micronutrients, the European Commission has specifically highlighted the need for harmonization of recommendations across Europe and signalled the areas in which this alignment must begin, namely, in the way in which scientific evidence is gathered, managed, interpreted and communicated to the users (European Commission, 2001). As a result, the European Network of Excellence Eurreca was established in 2007 to harmonize the process of setting micronutrient recommendations. Eurreca is entrusted with examining the processes of setting micronutrient recommendations, developing clear guidelines on how to achieve greater transparency, openness to user (and consumer) input and finding ways of achieving sustainability in this established process. It is our view that transparently derived uniform recommendations for Europe are conceptually possible on the basis of biologically based requirements for health. Subsequently, these recommendations provide a common basis for national nutritional policies that also account for extraneous variation due to biological and physical variation, health status of the population and national food habits. Details about the network and the results of its initial research activities are described elsewhere and in other papers within this supplement (http://www.eurreca.org, Ashwell *et al*., 2008; Doets *et al*., 2008; Pijls *et al*., 2009; Serra-Majem, 2009; Fairweather-Tait, 2008; Hooper *et al*., 2009). It is our view that a scientifically transparent and harmonized process will strengthen the evidence base for micronutrient requirements and policies and that this, in turn, will help to further specify and develop the required institutional architecture for Europe.

Presentation of the General Framework for development of micronutrient recommendations—scientific evidence and stakeholder involvement

The Eurreca network of excellence aims to develop a general framework describing the processes and stages of decision making that may influence (change in) policies. In particular, the General Framework considered the extent to which previous conceptualizations took into account the current sociopolitical realities, as well as pragmatic considerations associated with the process of setting micronutrient recommendations. In Box 2, we have briefly reviewed the existing conceptualizations of the process of setting micronutrient recommendations by three (inter)national organizations to take into account all relevant factors for our general framework.

Our proposed general framework (Figure 2) describes the process leading from assessing nutritional requirements to policy applications, on the basis of evidence from science (nutritional and consumer sciences), stakeholders and the sociopolitical context. It goes beyond other current frameworks (Taylor, 2008) as it not only focuses on derivation of nutrient recommendations as a process of scientific decision making but also includes political and consumer issues. Here, we present the updated general framework as put forward earlier by Ashwell *et al*. (2008).

The three dimensions of the framework

The framework basically illustrates three dimensions of the process of setting (micro)nutrient requirements:

(1) The logical sequence of scientific thinking from setting physiological requirements for nutritional health based on scientific evidence, leading to evidence-based derivation of nutrient intake values. Nutrient intake values (NIVs) are then translated into nutrient recommendations and policy options can be proposed and applied.

(2) The following types of data are considered throughout different stages of the framework: in the early stages of the process, nutritional and epidemiological science is the dominant source and addresses the physiological requirements for health; in the later stages, evidence on the distribution of usual intake from monitoring surveys, evidence on consumer behaviour and social sciences, as well as stakeholder expertise, are becoming increasingly relevant in determining the policy options for improving the distribution of nutrient intakes and the evaluation of the eventual effectiveness of policy applications.

(3) The wider sociopolitical context underlying and influencing the former two dimensions: the sequence from requirements to policy applications is not a linear process, nor is it based on science alone. The sociopolitical context within which decisions of scientific expert committees are made underlies this process. Influenced by institutional architecture, the balance between the influence of science and stakeholders shifts during the different stages of the framework. This reciprocity is noted in different areas of the sociopolitical context: The perception of actual health by consumers is directly affected by the food industry and by many other stakeholders, which generates a feedback loop between health perception and food intake; from the viewpoint of policymakers, population health indices, costs of health

Box 2 Description of frameworks for setting micronutrient recommendations used by United Nations University, Institute of Medicine (IoM) and Scientific Committee on Food

The United Nations University has put forward two frameworks in 2007 (King and Garza, 2007): (i) a conceptual framework for the various nutrient intake values (NIVs) and (ii) a framework for a pathway of application of NIVs. The Institute of Medicine has proposed a DRI framework consisting of the Study Committee, which uses data and research as the main input for evidence from which guidance on generic applications of DRIs can be formulated. At the EU level, the 1992 opinion of the Scientific Committee on Food (SCF) provided reference intakes for energy and certain nutrients (Commission of the European Communities, 1993).

The UNU-framework (i) for estimating average nutrient requirements (ANRs) is based on the distribution(s) of nutrient intakes which is required to achieve a specific outcome in a specified healthy population (King and Garza, 2007). Several biological factors, such as physiology, genetic variation and long-term health have been taken into account for the development of these NIVs. (ii) Several uses of NIVs were identified: assessing the adequacy of nutrient intakes; planning diets for individuals and populations; and developing food and nutrition policy (for example, planning of nutritional policies, strategies, programs, regulatory frameworks, legislation, marketing and labelling, research, product development, food procurement and trade, food aid and therapeutic nutrition). Evidence to date indicates that each of these uses of micronutrient recommendations are problematic and require further examination: first, the assessment of intake of adequacy of nutrient intakes is difficult, because the person's actual nutrient requirements are usually unknown, and an accurate measure of the person's usual, long-term nutrient intake is almost never available. Nevertheless, it is possible to estimate the confidence of adequacy of the usual intake, which considers the number of days on which the intake was observed, as well as how far the observed intake is above (or below) the ANR and the observed day-to-day variation in intake of that nutrient. It is however not clear how micronutrient recommendations translate into policies such as food-based dietary guidelines. Thus, the UNU framework fails to provide a comprehensive view of the process of setting micronutrient recommendations, as it does not address the lack of effective use of micronutrient recommendations. For instance, if their use by consumers in planning overall diet is to be enhanced, then it might be necessary to involve consumers and stakeholders early in the process of setting micronutrient recommendations in order to increase the usability of recommendations.

The DRI Framework of the Institute of Medicine explicitly recognizes the need for transparency of the decision-making process and facilitates the need for scientific judgment—in the face of limited data (Taylor, 2008). The DRI Framework is recognized as akin to that developed in other fields and referred to as risk analysis, and risk is considered here as nutrient intakes that are too low or too high. Risk analysis is composed of risk assessment, risk management and risk communication. The interface between nutritional risk management and nutritional risk assessment is a theme throughout DRI development considerations. The scientific advisory committees who are responsible for setting micronutrient recommendations are referred to as risk assessors. The activities surrounding DRI development have been differentiated as activities 'inside' the framework and 'outside' the DRI framework. Main 'inside' activities are based on a common understanding of the conceptual underpinnings and available scientific models. It is anticipated that stakeholders have opportunities for input (through identifying possible members) in committees, meetings, and reviewing reports related to DRIs as long as their input is consistent with the Federal Advisory Committee Act and the scientific integrity is ensured. Activities 'outside' the DRI framework relate to activities that generate basic data that are central to DRI development. Further, the framework addresses the general use of the micronutrient recommendations (assessing and planning diets and basis for food-based dietary guidelines), although its place is traditionally outside the remit of scientific advisory committees - risk management and communication. It appears that the IoM sees the process of DRI development merely as a scientific process in which users, consumers, and stakeholders play a less significant role. Moreover, it is necessary to recognize that, although working with the prerogative of independence, scientific advisory committees also have a political role as intermediaries between the scientific and policy community. This role should therefore be accounted for and recognized by the committee in their conceptualizations of their own workings.

The Scientific Committee on Food provided reference intakes for energy and certain nutrients (Commission of the European Communities, 1993). Currently, this advice is being reviewed and updated by the European Food Safety Authority (EFSA) to ensure that the Community action in the area of nutrition is underpinned by the latest available knowledge. To ensure a consistent approach the Panel has developed a draft on the principles for establishing Dietary Reference Values (DRV), including tolerable upper levels of intakes (UL) for vitamins and minerals. The EFSA describes that the DRVs can be used for different purposes, such as in diet assessment and diet planning, both at the population and individual level, but also as a basis for reference values in food labelling, and in establishing Food-Based Dietary Guidelines (FBDG). The European Commission has also asked EFSA to help public authorities in Member States in translating nutrient based recommendation into practical food-based guidelines. The draft scientific opinion on FBDG focuses on the scientific process underlying the development of FBDG in the EU and summarizes steps for their implementation, monitoring and evaluation. (EFSA Panel on Dietetic Products, Nutrition, and Allergies (NDA) (2010).

Providing the latest scientific advice, EFSA will support EU policy makers in their decision-making process in the field of nutrition. However, despite calls for opening up to consumer and stakeholder input, how this should be done is not specified.

care and economic interests in the agro-food sector drive concerns for health promotion and disease prevention; for research organizations, the debate between public governmental and private industrial parties fosters applied research and creativity to initiate new research.

Nutrient recommendations have an important role in modifying feedback loops, both through consumer behaviour and through stakeholder interests. In addition, it should be highlighted that—related to the third dimension—constraints that are imposed by scientific uncertainty end up into policy options and applications. Policy makers for instance may choose to ignore the issues around which there is a controversy, or adopt a precautionary approach to managing problems associated with considerable scientific uncertainty. Transparency needs to be achieved on what amount or type of evidence informs policy and what evidence is needed to achieve optimal health outcomes through policy processes. Furthermore, the lack of consumer understanding, as well as resistance to behaviour change, must be taken into account for science to effectively shape policy. Therefore, recommending ways to address behaviour should be carried out as early as possible in this process.

The four principal components of the framework

Apart from recommendations put forward by national or regional expert committees (Box 1), several bodies in the

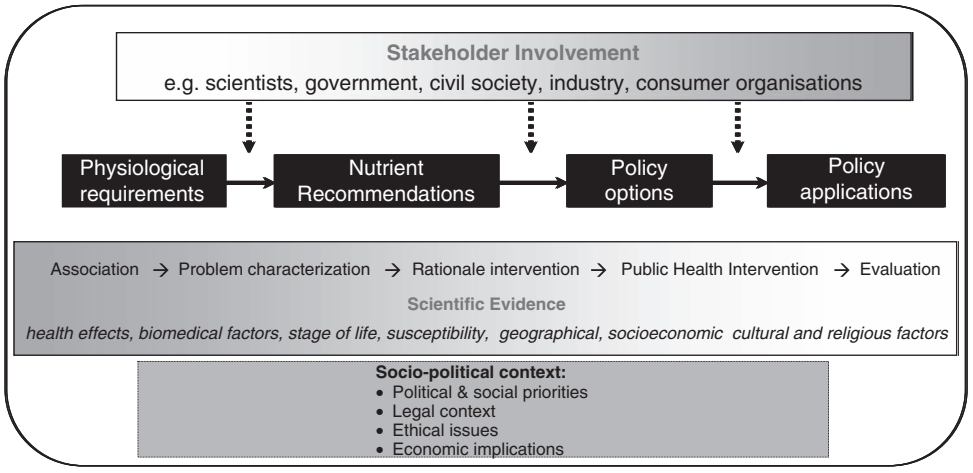

Figure 2 General Framework of and for EURRECA. The General Framework consists of four principal components or stages ranging from science to policy applications: requirements, nutrient recommendations, policy options and policy applications. Furthermore, the framework also covers three dimensions of the process of setting (micro)nutrient requirements: (1) the logical sequence of scientific thinking from setting physiological requirements for nutritional health, (2) the use of nutritional and epidemiological science in the early stages, and evidence from consumer and social sciences, as well as stakeholder influences, in later stages and (3) the wider sociopolitical context: a feedback loop between health perception, actual health and food intake, which is directly affected by the food industry and other stakeholders.

world (including Europe) that are involved in setting supranational recommendations have proposed frameworks to align (the process of) setting (micro)nutrient recommendations in a wider context. Box 2 summarizes three of such frameworks for the working of scientific advisory committees for nutrition. This has identified two main shortcomings of these frameworks that relate mainly to the political issue: (a) not recognizing the inherently political nature of the process of setting micronutrient recommendations, seeing it primarily as a scientific endeavour; and (b) not being clear about the need to understand the way in which micronutrient recommendations are translated (or not) into policy and are used by those they target. These shortcomings must be addressed by recognizing (1) the need for wider consultations by stakeholders, consumers and policy makers, and (2) applications around micronutrient recommendations as a means of achieving their greater effectiveness. The General Framework that Eurreca is proposing explicitly recognizes these imperatives for the process of setting micronutrient recommendations.

In explaining the link from science to policy applications, the framework distinguishes four principal components or stages, each relating to a specific way in which evidence is considered and used in decision making:

(1) *Defining the nutrient requirements for health*: Nutritional requirements are influenced by the association with biomedical factors, stage of life, acquired and inherited susceptibility, the effects of nutrients on health and so on. Not only does variation exist among individuals but nutrient requirements can also vary within an individual, because of the day-to-day variation (within an individual) (King *et al*., 2007). For estimating nutrient requirements, insight into the distribution of population requirements and into the relationship between physiological requirements and health is necessary.
The associations as described above can be used to derive average nutrient intake requirement (ANR) and their distribution (INLx). Because of the scarcity of data, many assumptions need to be made about the attributes of the population group. Each assumption is associated with uncertainty and a decrease in the level of confidence in the resulting requirements. Selection of criteria for the definition of population groups should be driven by evidence about physiology (such as life cycle, physical activity, energy needs, (biomarkers of) status, body weight and body composition; see also Figure 1) and the association with health outcomes.
In this phase, it is vital to be objective and consider all the existing, relevant scientific literature and current insights to define nutritional requirements. It is best to set up systematic reviews that transparently bring into picture which information is available and being used and which decisions are being made to come to specific requirements. Determining requirements is mainly an analytical scientific process.

(2) *Setting the nutrient recommendations*: The purpose of micronutrient recommendations is to 'represent the intakes of micronutrients sufficient to meet the requirements of the majority of (a group of) healthy individuals' and to 'provide guidelines for the nutrient composition of diets as a basis for good health and quality of life' (King and Garza, 2007). Given the cutoff point for a biomarker or health end point (or in more general terms, the criterion of adequacy that defines optimal health),

the requirement translates into a distribution of required intakes of a population.

The Institute of Medicine strongly urges the use of all available evidence to arrive at recommendations for serving (population) health. Incorporating different end points, each with a specific relevance to population groups (prevalence of exposure) and with different degrees of seriousness (health values), provides the basis for formulating an optimal diet in terms of micronutrients and macronutrients, non-nutrients and food(groups)s.

Here, the policy context comes in because of the choice of the cutoff point for health outcomes. This cutoff point can be seen as the 'acceptable risk or level' that policy decides upon. To help policy makers in achieving realistic nutrient recommendations, a range of cutoff points for several levels of health outcome could be presented, together with intake distributions, and described as problem characterization. This can help policy makers to balance different health objectives and achievable levels of intake.

(3) *Policy options*: Policy options should be formulated in terms of possible interventions while distinguishing levels, such as European, national and regional levels, characteristics of risk groups, as well as consumer behaviour of the population segments addressed. Policy options relate to the advice of scientists and/or expert committees to policy makers regarding the nutrient policy options available to achieve the levels of micronutrients recommended for a particular population group (Department of Health, 2000).

Policy options that are currently being used include setting up a task force, food-based dietary guidelines, general health education, educational programme for specific group(s), fortification (voluntary or mandatory), labelling, supplementation (general or for specific groups), inducing voluntary action in industry, legislation on micronutrient composition in food products, fiscal change, monitoring and evaluation of intake (through food consumption surveys) and/or nutritional status (King and Garza, 2007).

There has been a dynamic shift in the EU food and nutrition policy, from the classical single-nutrient problem areas addressed (such as nutrition deficiencies) to the well-being and health of the whole population, with an aim to achieve 'optimal health' (European Commission, 2006). As a result, the focus of nutrition policy is shifting to incorporate the need to address the interactions and effects of two or more nutrients, instead of a single micronutrient, in the diet as a whole. For this reason, evidence other than scientific (for example, the knowledge of consumer diet-related behaviour) needs to be considered in making decisions about policy options to recommend those that depend among others on (cost-) effectiveness and feasibility.

(4) *Policy applications*: Policy applications represent policies and planning, usually carried out by government, that lead to the actual conduct of nutritional interventions or programmes. They usually require consideration of scientific and other matters, such as legal and regulatory issues, economic implications, ethical and cultural issues, political and social priorities. To identify successful interventions for particular population groups, it is crucial to specify models linking policy applications, underlying models of behaviour change and the external catalysts on which they are based. In the context of evidence-based policy and accountability, the end result of this process requires a careful evaluation of processes and effects.

Discussion

We have proposed here a General Framework for setting micronutrient recommendations that can serve as a basis for the decision making of scientific advisory bodies, policy makers and stakeholders involved in this process of assessing, developing and translating these recommendations into public health nutrition policy. The unique aspect of the General Framework as presented here is that it recognizes the need to bring together the process of knowledge formation (the stages from setting requirements to setting recommendations) and the process of knowledge translation (the process through which nutrient recommendation ends up in policy).

Although represented as a linear sequence of stages through which the decision-making process evolves, importantly, it recognizes the range of internal and external factors affecting the process, as well as the reciprocities and feedback loops characterizing the decision-making dynamics. The extent to which its apparent linearity maps onto real-world situations and the degree to which the fuzziness of science and the social context reduces the Framework's applicability needs to be validated (as is also discussed in the current issue by Timotijevic *et al*., 2010).

Although most previous models and frameworks of the decision-making processes of the scientific advisory bodies for nutrition view it in isolation from the broader social context, the Eurreca framework recognizes a whole spectrum of contingencies. Such a recognition is important for a number of reasons: the aim of the General Framework (and the decision-making tools that it will generate) is to aid those involved in the decision making process with a way of addressing the basic aims and opportunities of their decision making. Further, the policy imperative of transparency is built into the model. Finally, it calls for the inclusion of considerations of experts from disciplines other than nutrition and health, as well as the stakeholders and consumers who might be affected by the outcomes of the process. This approach requires clarity about the procedures for weighing evidence, clear communication of the areas of scientific uncertainty and also openness about how the problem is framed for/by the scientific advisory bodies for nutrition.

This, therefore, should make it more explicit to those involved in the decision-making process when, how and which stakeholders to involve in the process. Current efforts of the Eurreca network of excellence involve collation of evidence, and developing decision-making tools that form the basis of the General Framework. This will be achieved through systematic reviews of micronutrient intake and biomarkers of exposure or status (briefly 'intake-status', I-S), as well as of micronutrient intake and health end points ('intake-health', I-H), and biomarkers of micronutrient status and health outcomes ('status-health', S-H). Through the results from these systematic reviews, meta-analyses can be performed that systematically and quantitatively assess the dose–response relationships relevant to deriving micronutrient recommendations on the basis of epidemiological studies (such as intervention, cohort, nested case–control and cross-sectional studies) and physiological studies that take into account bioavailability and factorial methods. From the systematic and quantitative overview obtained through meta-analyses, transparent procedures can be developed to model the evidence on 'intake-status and health' (I-S-H), factorial requirement and the bioavailability relevant to setting Average Nutrient Requirements (ANR) and Individual Nutrient Level (INLx).

Aided by our General Framework, reviews of other disciplines such as the sociological examination of the processes of decision making in scientific advisory bodies and the involvement of stakeholders and the public can be brought together and will have wide applicability across a range of decision domains, from nutrition science to policy. While doing this, it will consider consumer issues that will ultimately influence applicability of recommendations and their effectiveness in shifting nutrient intake so that it is in line with the recommendations.

The utility of the General Framework as a conceptual guide for the development of decision-making tools for scientists and policy makers remains to be tested. Its applicability—with inclusion of scientific status, policy relevance and implications for consumer behaviour—should be examined against a number of micronutrients.

The General Framework embodies the first systematic approach for the development and regular review of micronutrient requirements in Europe, transparently based on scientific evidence and best practices aimed at achieving policy applications. As such, it is an important step towards sound nutritional science as a basis for transparent, and reliably informing, decision-making bodies in European food and nutrition policy.

Key informants

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Conflict of interest

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