

1 Introduction

1.1 Evolution of RDA

The first recommendation was reported by Dr. E Smith (1862) during the “Cotton Famine” to determine the least cost for which sufficient food could be purchased to prevent starvation and associated diseases in economically depressed and unemployed populations in the United Kingdom (UK). During the First World War (1914-1919), a recommendation was set for energy (Lusk) and to feed the army and nation in the UK. This was followed by the recommendations “to maintain health and working capacity” during the depression in 1933 by the British Medical Association. In 1936, the Technical Commission of the Health Committee of the League of Nations (TCHC-LON, 1936) published its first nutrient-based dietary standards which sought to answer the following questions: What are the nutritional needs of human beings? How can they be recognized? How can it be determined that they are being satisfied? The concern over malnourished US military personnel during the Second World War led to the enrichment of wheat, corn and rice flour with thiamin, riboflavin and niacin. In 1941, the US National Research Council proposed a recommendation with the aim of “building up of our people to a level of health and vigour never before attained or dreamed of” (NRC, 1941).

Recommended Dietary Allowance (RDA) has been prepared by the United States Food and Nutrition Board (FNB) since 1941. The first edition was published in 1943 to provide “standards to serve as a goal for good nutrition.” Because RDA are intended to reflect the best scientific judgment on nutrient allowances for the maintenance of good health and to serve as the basis for evaluating the adequacy of diets of groups of people, the initial publication has been revised periodically to incorporate new scientific knowledge and interpretations. The RDAs were then replaced by Dietary Reference Intakes (DRIs) which refers to a set of 4 nutrient-based reference values (EAR, RDA, AI and UL). The first set of DRI for calcium and related nutrients was published in 1997 and subsequently followed by sets covering other nutrients (IOM, 1997, 1998, 2000, 2001 and 2002).

In 1993, the European Union (EU) Scientific Committee for Food published Population Reference Intakes (PRIs) for the European Union in a report entitled “Nutrient and Energy Intakes for the European Community” (CEC,1993).

A FAO/WHO Consultation on Human Vitamin and Mineral Requirements was convened in Bangkok, Thailand in 1998 and the report was published in 2002 (FAO/WHO, 2002).

In Malaysia, a Technical Sub-Committee was formed in 1969 with representatives from the Institute for Medical Research and Public Health Institute of the Ministry of Health, WHO and University of Malaya “to provide advice on dietary aspects of the then proposed Applied Nutrition Pilot Project”. This group prepared a new dietary standard based on various WHO recommendations published between 1962 and 1973 (Teoh, 1975) which was subsequently published as the Malaysian RDI in 1975. The task of reviewing and revising the 1975 RDA was assigned to the Technical Working Group

(TWG) on Nutritional Guidelines established under the National Coordinating Committee on Food and Nutrition (NCCFN), Ministry of Health Malaysia. The first meeting of the Technical Committee was held on the 20th September 2002 and consequently, three Sub-Committees were established namely, the Technical Sub-Committee on Energy and Macronutrients, Vitamins and Minerals to prepare the draft of the revised dietary recommendations for Malaysia.

1.2 Nomenclature and interpretations

A variety of terms are commonly used with reference to dietary recommendations, including terms such as recommended dietary allowances, recommended daily allowances, recommended daily amounts, recommended nutrient intakes, among others. In this monograph, the term Recommended Nutrient Intake (RNI) has been adopted by the Consensus Workshop participants.

The Food and Nutrition Board that devised the RDAs in the USA defined Recommended Daily Allowance as “the level of intake of essential nutrients that, on the basis of scientific knowledge, are judged by the Food and Nutrition Board to be adequate to meet the known nutrient needs of practically all healthy persons” (NRC,1980). Although new information is available as a result of the development of more precise techniques of determining human nutritional requirements, the definition has remained essentially unchanged since the 8th edition (NRC, 1974).

The EU Scientific Committee for Food developed a new nomenclature with respect to dietary recommendations (CEC, 1993). This nomenclature is based on the frequency of distribution of individual requirements for a nutrient, which is shown in Figure 1.1.

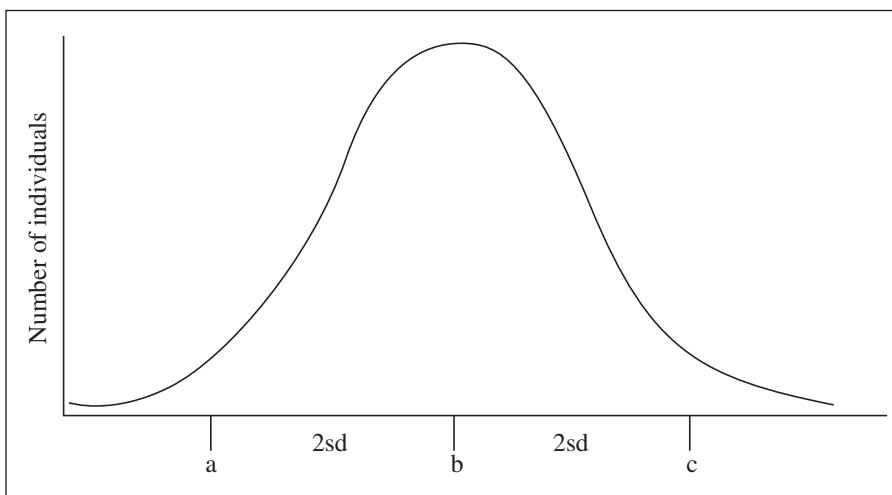


Figure 1.1 Conceptual framework for the European community's nutrient-based recommendations
Source: CEC (1993)

Point “b” represents the mean requirement of the population. This is referred to as the *average requirement*. Point “c” equals the mean requirement plus two standard deviations (SD) that is, meeting the dietary requirements of nearly all (97.5%) healthy people in the population. This requirement is referred to as the *population reference intake (PRI)* and corresponds with the commonly used term RDA. Point “a” represents the mean minus 2SD, that is, an intake below which nearly all individuals will be unable to maintain metabolic integrity according to the criterion chosen and this point is referred to as the lowest threshold intake (LTI). The three reference levels of intake were devised because the single value of the RDA is often misinterpreted. Despite being clearly defined as substantially more than an individual needs, the RDA or PRI is often regarded as the lowest acceptable intake for the majority of the population.

A Joint FAO/WHO Expert Consultation on Human Vitamin and Mineral Requirements (FAO/WHO, 2002) proposed a definition that relate to the nutrient intake from food (including water) that is required to prevent deficiency conditions. Upper limits of nutrient intake are defined for specific vitamins and minerals where there is potential problem with excess.

A requirement is an intake level, which will meet specified criteria of adequacy, preventing risk of deficit or excess. These criteria include a gradient of biological effects related to the nutrient intake. This dose response will be assumed to have a Gaussian distribution unless it is known to be otherwise. A risk function (a probability of 0 to 1) of deficiency and excess can be derived (Figure 1.2)

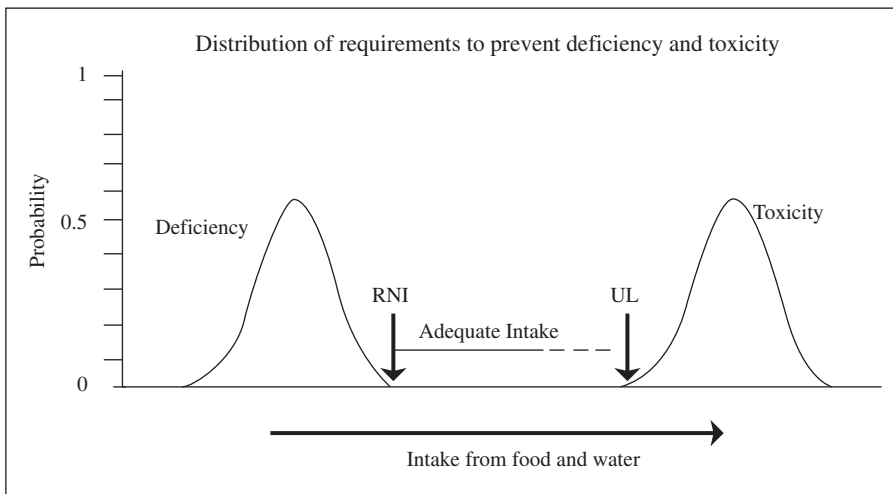


Figure 1.2 Conceptual framework for FAO/WHO’s recommended nutrient intake
Source: FAO/WHO (2002)

The gradient of biological effects of nutrient intakes ranges from the prevention of deficiency, the most extreme of which is death, to adequacy, to prevention of toxicity. Biochemical or functional assays of sub-clinical conditions and measurements of nutrient stores of critical tissue pools are used to identify the range of intakes that will prevent deficiency while avoiding toxicity.

The recommended nutrient intake (RNI) is the daily intake corresponding to RDA, which meets the nutrient requirements of almost all (97.5%) apparently healthy individuals. Upper tolerable nutrient intake levels (ULs) have been defined for some nutrients. ULs are the maximum intake from food that is unlikely to pose risk of adverse health effects from excess in almost all (97.5%) apparently healthy individuals in an age and sex-specific population group. The range of intakes encompassed by the RNI and UL should be considered sufficient to prevent deficiency while avoiding toxicity.

The concept of protective nutrient intake has been introduced in some cases to refer to an amount greater than the RNI, which may be protective against a specified health or nutritional risk of public health relevance (e.g. vitamin C intake with a meal to promote iron absorption or folic acid to lower the risk of neural tube defects).

To address the issues resulting from the application of a single value, the RDA, to a variety of uses and to incorporate the concept of reduction of risk to chronic degenerative diseases, the US Food and Nutrition Board (FNB), in collaboration with Health Canada (HC) and the Canadian National Institute of Nutrition (CNIN), developed four types of nutrient-based reference values, each for a particular use or uses, and collectively called “Dietary Reference Intakes” or DRIs (IOM, 2000). The DRIs include *Estimated Average Requirement (EAR)*, *Recommended Dietary Allowance (RDA)*, *Adequate Intake (AI)* and *Tolerable Upper Intake Level (UL)* as shown in Figure 1.3.

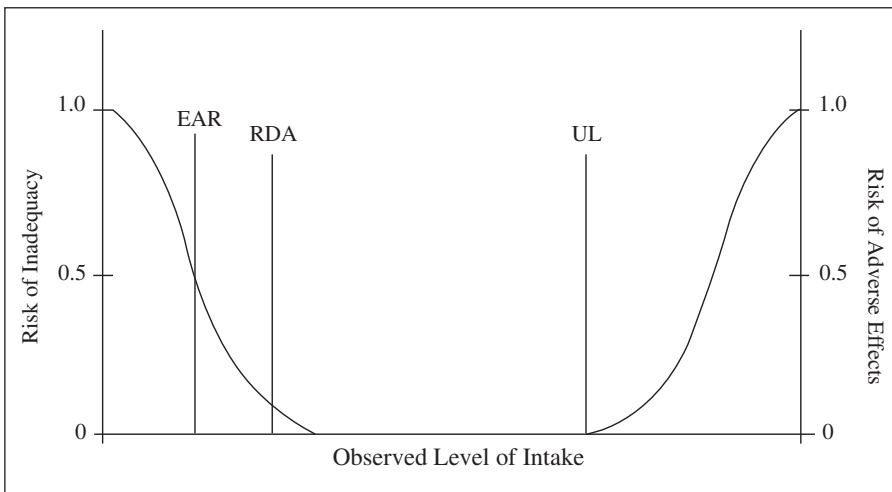


Figure 1.3 Conceptual framework for IOM/FNB's DRIs

Source: IOM (2001)

The estimated average requirement (EAR) is the median intake value that is estimated to meet the requirement, as defined by specified indicator of adequacy, in half of the individuals in a life-stage or gender group. At this level of intake, the other half of a specified group will not have its nutritional needs met. The EAR is used to calculate the RDA.

The *recommended dietary allowance* (RDA) is the average daily dietary intake level that is sufficient to meet the requirement of nearly all healthy individuals in a particular life stage and gender group. If the distribution of requirement of the group is assumed to be normal, then the RDA is the value that exceeds requirement of 97 to 98 percent of the individuals in the group. The RDA is intended for use primarily as a goal for usual intake of individuals.

If sufficient scientific evidence is not available to establish an EAR and set a RDA, an *adequate intake* (AI) is derived instead. The AI is based on experimentally derived intake levels or approximations of observed mean nutrient intakes by a group (or groups) of apparently healthy people who are maintaining a defined nutritional state or criterion of adequacy.

The tolerable upper intake level (UL) is the highest level of continuing daily nutrient intake that is likely to pose no risk of adverse health effects in almost all individuals in the specified life stage group. As intake increases above the UL, the potential risk of diverse effects increases. The term tolerable intake was chosen to avoid implying a possible beneficial effect. The UL is not intended to be a recommended level of intake.

The evolution of nutrient-based dietary standards may be summarized as: a broadening of the goals from prevention of nutritional deficiency status to promotion of optimum health and improved quality of life which includes reduction of the risk of chronic diseases and avoidance of excessive intakes of certain nutrients, a shift from a single to multiple reference standards, expansion of nutrients covered and changes in terminology (FNRI, 2002).

1.3 Age-categories and reference weights

With the exception of energy requirements, the Recommended Nutrient Intakes for Malaysia Consensus Workshop participants adopted the FAO/WHO (2002) age-categories to describe the Malaysian population. The reference weights for the various age categories were derived from several local studies (Lim *et al.*, 2000; MOH, 2001; UKM, 2001; UKM, 2004). The reference weights for adult males and females adopted for use in the revised RNI are 62 kg and 55 kg as compared to 55 kg and 50 kg in the previous Malaysian RDA (Teoh, 1975), respectively. For the elderly male, the reference weight to be used is 57 kg as compared to 55 kg and 49kg for females as compared to 50

kg (Teoh, 1975). The reference weights according to age groupings to be used in the revised Malaysian RNIs are shown in Table 1.1.

Table 1.1 Age categories and reference body weights of the Malaysian population

Age group	Body weight (kg)	
	Males	Females
0 – 5 months	6	6
6 – 11 months	8	8
1 – 3 years	12	11
4 – 6 years	18	18
7 – 9 years	26	25
10 – 12 years	36	37
13 – 15 years	53	49
16 – 18 years	59	52
20 – 29 years	61	52
30 – 59 years	64	57
≥ 60 years	57	49

Source: 0 – 5 years: MOH (2000)
 6 –12 years: UKM (2001)
 12 –18 years: UKM (2004)
 ≥20 years: Lim *et al.* (2000)

1.4 Coverage of nutrients

Recommendations are given for the following nutrients in the revised Malaysian RNI:

- Energy
- Macronutrients including protein, fat, and carbohydrates
- Vitamins
 - Thiamin (Vitamin B₁)
 - Riboflavin (Vitamin B₂)
 - Niacin (Vitamin B₃)
 - Folate
 - Vitamin C
 - Vitamin A
 - Vitamin D
 - Vitamin E
- Minerals
 - Calcium
 - Iron
 - Iodine
 - Zinc
 - Selenium

1.5 Uses of RNI

The uses of recommended nutrient intakes (RNI) include the following:

- In planning for procuring food supplies, stockpile of food for emergencies and as a tool for monitoring national food supplies
- In food programme, to ensure adequate nutrients are present in food intervention programmes
- Evaluating dietary intakes of high risk groups and identifying nutrients at risk of being consumed in inadequate amounts by certain groups
- Nutrition education as part of food selection guides and guidelines for obtaining nutritionally adequate diets
- As a reference point for the nutrition labeling of food and dietary supplements and for making nutrient claims on food products
- In food products development and food fortification
- In marketing, to assist food industry to communicate product benefits, to educate consumers and to contribute to competitive marketing between brands
- In clinical dietetics practice, for example to develop therapeutics diet manuals, plan modified diets, assess individual diets and plan menus and food served in a variety of institutions
- Evaluation of nutritional quality of foods by calculating the nutrient density index
- As a reference standard for nutrient values when communicating findings of various intake and epidemiological studies

There are, however, some uncertainties in setting RNIs. These include the parameter chosen as basis for nutritional adequacy, the completeness or limitation of the available database and the precision and accuracy of dietary intake data. There is thus a need for “best” judgment in setting RNIs (IOM, 1998).

1.6 References

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