

Nutrient requirements and optimisation of intakes

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In 1991, dietary reference values were published in the UK. These refer to nutrients and provide the basis for dietary advice. To complement this, practical food-based guidance on how to plan a healthy and balanced diet has been developed. Interest continues in how best to establish guidance which helps individuals modify their diets so as to better match the dietary targets established as a means of promoting health and avoiding disease.

Furthermore, in recent years, interest has grown in the potential to optimise nutrition and so promote health and well-being, rather than just avoiding deficiency. This has been accompanied by an awareness that many foods, particularly plant foods, contain substances that may have health promoting properties but are not, as yet, regarded as conventional nutrients.

It has been recognised for some time that, for health and the normal functioning of the body, humans need to consume foods and drinks that are sources of energy (calories) and which together provide protein and contain a specific range of vitamins, minerals and trace elements. However, awareness is now growing of the provision by foods, especially plant foods, of a wide variety of substances that are yet to be recognised as nutrients as such, but which may confer health-promoting properties. These phytochemicals are represented in nature by various groups of structures that together include 3000–4000 individual compounds, and which possess a number of different properties. For example, they may have antioxidant characteristics which are believed to allow them to protect the body against the harmful effects of products produced as a result of oxidation. In the past 10 years, there has been considerable growth in research interest in optimal nutrition, which has developed from a focus on nutrient protection in relation to free radical induced cellular damage. This rapidly growing body of research is currently the focus of a British Nutrition Foundation task force, due to report in 2001.

An optimal diet has been defined as one that maximises health and longevity and, therefore, prevents nutrient deficiencies, reduces risks of diet-related chronic diseases, and is composed of foods that are safe and palatable¹. Throughout the course of human history, societies have

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developed a considerable range of dietary patterns that took advantage of the food plants and animals available to them, as a result of local climate, geography and trade. It follows that the diets of those communities that survived must have provided sufficient energy and nutrients to support growth and reproduction, but whether they adequately promoted adult health is more difficult to determine. Evidence of the sharp increases in human life expectancy observed in this century suggests this to have been unlikely¹.

Requirements for a specific nutrient differ from one individual to another. In particular, they vary with age, gender and life-stage (e.g. pregnancy, lactation). Furthermore, the composition and nature of the diet as a whole may affect the efficiency with which nutrients are absorbed and/or utilised².

Classically, an individual's requirement for a nutrient has been the amount required to prevent clinical signs of deficiency. Whilst this remains an important facet of the process that is undertaken in the definition of the nutrient needs of populations, it is now acknowledged that allowance needs to be made for individual variation and for losses of the nutrient that might occur during storage or processing the particular foods that make a major contribution to its intake. It has also been suggested that levels of intake considerably higher than those that arise as a result of the above considerations, may have particular beneficial or therapeutic effects. However, equally, it is acknowledged that some nutrients can be toxic if consumed in large quantities, for example selenium².

Dietary Reference Values – what are they?

In the UK, the most recent published review of advice on dietary intakes of energy and nutrients is contained in *Dietary Reference Values for Food Energy and Nutrients*, which is a report from the Committee on Medical Aspects of Food Policy (COMA), an advisory group to Government². This report broke new ground in that, instead of publishing single figures for the vitamin and mineral needs of each population sub-group, it published a range of figures, known as Dietary Reference Values. A similar approach has subsequently been adopted in North America³. This range is based on the Estimated Average Requirement (EAR) for the population group in question, and incorporates the Reference Nutrient Intake (RNI), calculated to meet the needs of 97.5% of the population sub-group to which it relates, and the Lower Reference Nutrient Intake (LRNI), calculated to be sufficient for only 2.5% of the population sub-group². In practice, the RNI, which replaces the old Recommended Daily (or dietary) Amount (RDA) is used

Table 1 Reference Nutrient Intakes for vitamins

Age	Thiamin mg/day	Riboflavin mg/day	Niacin (nicotinic acid equivalent) mg/day	Vitamin B6 # mg/day	Vitamin B12 µg/day	Folate µg/day	Vitamin C mg/d	Vitamin A µg/day	Vitamin D µg/day
0-3 months	0.2	0.4	3	0.2	0.3	50	25	350	8.5
4-6 months	0.2	0.4	3	0.2	0.3	50	25	350	8.5
7-9 months	0.2	0.4	4	0.3	0.4	50	25	350	7
10-12 months	0.3	0.4	5	0.4	0.4	50	25	350	7
1-3 years	0.5	0.6	8	0.7	0.5	70	30	400	7
4-6 years	0.7	0.8	11	0.9	0.8	100	30	500	-
7-10 years	0.7	1.0	12	1.0	1.0	150	30	500	-
Males									
11-14 years	0.9	1.2	15	1.2	1.2	200	35	600	-
15-18 years	1.1	1.3	18	1.5	1.5	200	40	700	-
19-50 years	1.0	1.3	17	1.4	1.5	200	40	700	-
50+ years	0.9	1.3	16	1.4	1.5	200	40	700	**
Females									
11-14 years	0.7	1.1	12	1.0	1.2	200	35	600	-
15-18 years	0.8	1.1	14	1.2	1.5	200	40	600	-
19-50 years	0.8	1.1	13	1.2	1.5	200	40	600	-
50+ years	0.8	1.1	12	1.2	1.5	200	40	600	-
Pregnancy	+0.1***	+0.3	*	*	*	+100	+10	+100	10
Lactation									
0-4 months	+0.2	+0.5	+2	*	+0.5	+60	+30	+350	10
4+ months	+0.2	+0.5	+2	*	+0.5	+60	+30	+350	10

*No increment, **after age 65 years the RNI is 10 µg/day for men and women, ***for last trimester only, #based on protein providing 14.7% of EAR for energy

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as a point of reference against which to assess the average intakes of sub-groups of the population and the LRNI is used to assess the suitability of intakes that fall at the lower end of the spectrum. However, it is important to recognise that all these values apply to **populations**, and not to the needs of **individuals**. They are yardsticks to be used in determining the adequacy of the diets of **groups** of people. However, some assumptions can be made, which err on the side of caution and which allow the values to be used in the assessment of individual patients' diets.

- 1 If an individual is routinely consuming the RNI for a particular nutrient, it can be assumed that his or her diet provides adequate amounts (or more than adequate amounts) of that nutrient. However, if intake is regularly below the RNI, it cannot necessarily be assumed that the diet is inadequate as that person may have a lower requirement than average for that particular nutrient.

- 2 If an individual is consistently consuming less than the LRNI for a nutrient, it can be assumed that his or her diet is deficient in that particular nutrient, although this does not imply that the person is clinically ill.
- 3 The DRVs refer to the needs of healthy people and it can not be assumed that the needs of those who are ill are identical. In some instances, their individual needs may be greater for some nutrients.

Reference values exist for energy, fat, non-starch polysaccharides (dietary fibre), sugars, starch, protein, vitamin A, thiamin, riboflavin, niacin (and tryptophan), vitamin B6, vitamin B12, folate, vitamin C, vitamin D, calcium, magnesium, phosphorus, sodium, potassium, chloride, iron, zinc, copper, selenium, and iodine². Reference Nutrient Intakes (RNIs) for vitamins and minerals are shown in Tables 1 and 2, respectively.

Although, the RNIs should not be regarded as targets to be above, in most cases, if the RNI is exceeded 2–3-fold as a result of a high dietary

Table 2 Reference Nutrient Intakes for minerals

Age	Calcium mg/day	Phosphorus* mg/day	Magnesium mg/day	Sodium ^b mg/day	Potassium ^c mg/day	Chloride ^d mg/day	Iron mg/day	Zinc mg/day	Copper mg/day	Selenium µg/d	Iodine µg/d
0–3 months	525	400	55	210	800	320	1.7	4.0	0.2	10	50
4–6 months	525	400	60	280	850	400	4.3	4.0	0.3	13	60
7–9 months	525	400	75	320	700	500	7.8	5.0	0.3	10	60
10–12 months	525	400	80	350	700	500	7.8	5.0	0.3	10	60
1–3 years	350	270	85	500	800	800	6.9	5.0	0.4	15	70
4–6 years	450	350	120	700	1100	1100	6.1	6.5	0.6	20	100
7–10 years	550	450	200	1200	2000	1800	8.7	7.0	0.7	30	110
Males											
11–14 years	1000	775	280	1600	3100	2500	11.3	9.0	0.8	45	130
15–18 years	1000	775	300	1600	3500	2500	11.3	9.5	1.0	70	140
19–50 years	700	550	300	1600	3500	2500	8.7	9.5	1.2	75	140
50+ years	700	550	300	1600	3500	2500	8.7	9.5	1.2	75	140
Females											
11–14 years	800	625	280	1600	3100	2500	14.8*	9.0	0.8	45	130
15–18 years	800	625	300	1600	3500	2500	14.8*	7.0	1.0	60	140
19–50 years	700	550	270	1600	3500	2500	14.8*	7.0	1.2	60	140
50+ years	700	550	270	1600	3500	2500	8.7	7.0	1.2	60	140
Pregnancy	*	*	*	*	*	*	*	*	*	*	*
Lactation											
0–4 months	+550	+440	+50	*	*	*	*	+6.0	+0.3	+15	*
4+ months	+550	+440	+50	*	*	*	*	+2.5	+0.3	+15	*

*No increment, *phosphorus RNI is set equal to calcium in molar terms, ^b1 mmol sodium = 23 mg, ^c1 mmol potassium = 39 mg,

^dcorresponds to sodium 1 mmol = 35.5 mg, *insufficient for women with high menstrual losses where the most practical way of meeting iron requirements is to take iron supplements

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Table 3 Estimated Average Requirements (EARs) for energy

Age	EARs MJ/day (kcal/day)	
	Males	Females
0-3 months	2 28 (545)	2 16 (515)
4-6 months	2 89 (690)	2 69 (645)
7-9 months	3 44 (825)	3 20 (765)
10-12 months	3 85 (920)	3 61 (865)
1-3 years	5 15 (1230)	4 86 (1165)
4-6 years	7 16 (1715)	6 46 (1545)
7-10 years	8 24 (1970)	7 28 (1740)
11-14 years	9 27 (2220)	7 92 (1845)
15-18 years	11 51 (2755)	8 83 (2110)
19-50 years	10 60 (2550)	8 10 (1940)
51-59 years	10 60 (2550)	8 00 (1990)
60-64 years	9 93 (2380)	7 99 (1900)
65-74 years	9 71 (2330)	7 96 (1900)
75+ years	8 77 (2100)	7 61 (1810)
Pregnancy		+0 80* (200)
Lactation		
1 month		+1 90 (450)
2 months		+2 20 (530)
3 months		+2 40 (570)
4-6 months (Group 1)		+2 00 (480)
4-6 months (Group 2)		+2 40 (570)
> 6 months (Group 1)		+1 00 (240)
> 6 months (Group 2)		+2 30 (550)

*Last trimester only

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intake, this will not pose a problem for most people. However, there are exceptions to this, *e.g.* sodium. The RNI for sodium is 1.6 g/day, which is equivalent to about 4 g NaCl/day. This amount is estimated to meet most people's needs for sodium and yet the current average intake is about 9 g NaCl/day. In 1994, COMA recommended a decrease to 6 g/day, a reduction of about a third. Achieving this specific recommendation, alongside all the others that exist, can be particularly difficult.

Only Estimated Average Requirements (EARs) exist for energy (calories) (Table 3) because it is important that individuals match their energy intake to their requirement in order to avoid losing or gaining weight; for most other nutrients there is a wide range of tolerance². Having said this, an increasing number of individuals are consuming more energy than they need.

Energy intakes have been falling over a number of years, presumably as a result of the lower energy requirements associated with a more sedentary life-style, and are currently below the EAR. Despite this, the proportion of men and women who are overweight reached 62% and

Table 4 Dietary Reference Values for fat and carbohydrate for adults as a percentage of daily total energy intake (percentage of food energy)

	Individual minimum	Population average	Individual maximum
Saturated fatty acids		10 (11)	
<i>Cis</i> -polyunsaturated fatty acids		6 (6.5)	10
	n-3 0.2		
	n-6 1.0		
<i>Cis</i> -mono-unsaturated fatty acids		12 (13)	
<i>Trans</i> fatty acids		2 (2)	
Total fatty acids		30 (32.5)	
TOTAL FAT		33 (35)	
Non-milk extrinsic sugars	0	10 (11)	
Intrinsic and milk sugars and starch		37 (39)	
TOTAL CARBOHYDRATE		47 (50)	
NON-STARCH POLYSACCHARIDE (g/day)	12	18	24

The average percentage contribution to total energy does not total 100% because figures for protein and alcohol are excluded. Protein intakes average 15% of total energy which is above the RNI. It is recognised that many individuals will derive some energy from alcohol, and this has been assumed to average 5% approximating to current intakes. However, the Panel allowed that some groups might not drink alcohol and that, for some purposes, nutrient intakes as a proportion of food energy (without alcohol) might be useful. Therefore, average figures are given as percentages both of total energy and, in brackets, of food energy.

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53%, respectively, in 1997, having been 39% and 32%, respectively, in 1980^{3,5}. Included within this figure is a prevalence of obesity of 17% in men and 20% in women⁴. By contrast, in 1980, 6% of men and 8% of women were obese⁵. This trend is an indication of an increasing public health problem that needs urgent attention⁶.

For fat, sugars and starches, because there is no absolute requirement for any of these individually, it was not possible to derive a range of reference figures. Instead, the COMA Panel² made pragmatic judgments based on the changes from current intakes that would be expected to result in specific changes in physiological and/or health outcomes, particularly in relation to coronary heart disease (see Table 4). Almost 10 years later, a reduction in deaths from coronary heart disease and cancer remain national targets in the UK⁷.

Since publication of the Dietary Reference Values (DRV) report, COMA has advised the need to adjust the ratio of n-3 and n-6 fatty acids in the diet in favour of the former⁸. COMA suggests this could be achieved by increasing fish consumption to two servings per week, one of which is oil-rich fish, which might be expected to achieve a weekly

Table 5 Safe intakes for nutrients for which insufficient information exists to set DRVs

Nutrient		Safe intakes
<i>Vitamins</i>		
Pantothenic acid	Adults	3–7 mg/day
	Infants	1.7 mg/day
Biotin		10–200 µg/day
Vitamin E	Men	Above 4 mg/day
	Women	Above 3 mg/day
	Infants	0.4 mg/g polyunsaturated fatty acids
Vitamin K	Adults	1 µg/kg/day
	Infants	10 µg/day
<i>Minerals</i>		
Manganese	Adults	1.4 mg (26 µmol)/day
	Infants and children	16 µg (0.3 µmol)/day
Molybdenum	Adults	50–400 µg/day
	Infants, children and adolescents	0.5–1.5 µg/kg/day
Chromium	Adults	25 µg (0.5 µmol)/day
	Children and adolescents	0.1–1.0 µg (2–20 µmol)/kg/day
Fluoride (for infants only)		0.05 mg (3 µmol)/kg/day

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intake of very long chain n–3 fatty acids of 1.5 g/week. More details are available in a BNF publication on this subject⁹.

Insufficient evidence was considered to be available to set DRVs for pantothenic acid, biotin, vitamin E, vitamin K, molybdenum, manganese, chromium and fluoride; instead, safe intakes were published (Table 5). A safe intake is a range of intakes sufficient to meet the needs of almost all individuals, but not high enough to cause undesirable effects².

All of the DRVs are intended to be met, on average, over a period of days, rather than on a single day, and can be used in many ways. They are used by dietitians as a yardstick in the assessment of the adequacy of the diets of individuals. But expertise and caution is needed when using the values for this purpose. DRVs give a general guide to whether or not an individual's diet is likely to be nutritionally adequate. However, it is very difficult, even with considerable experience, to get a precise estimate of an individual's food intake and it is not possible to accurately predict a person's requirement for nutrients.

The values are also used to interpret the dietary data collected in national surveys, to establish whether the national diet is adequate in

Table 6 Proportion of subjects in the survey of British adults, by age, whose intakes fell below the LRNI values for various nutrients

Nutrient	Age 16–18 years		Age 19–50 years		Age 51–64 years	
	LRNI	%	LRNI	%	LRNI	%
Calcium (mg)	480	27	400	10	400	5
Iron (mg)	8	33	8	26	8	1
Magnesium (mg)	190	39	150	13	150	9
Potassium (mg)	2000	30	2000	27	2000	23
Zinc (mg)	4	6	4	4	4	2
Iodine (µg)	70	4	70	3	70	3
Vitamin A (µg)	250	7	250	3	250	2
Riboflavin (mg)	0.8	9	0.8	8	0.8	5
Vitamin C (mg)	10	0	10	1	10	1
Folate (µg)	100	4	100	4	100	3
Vitamin B12 (µg)	1.0	4	1.0	1	1.0	1

Data taken from Ministry of Agriculture, Fisheries and Food¹⁰

respect to the provision of various nutrients for a range of age groups. Data from the survey of British adults can be used to demonstrate this point¹⁰. Table 6 shows the LRNI values for a number of vitamins and minerals measured in the survey. Using these figures, the survey reveals that a considerable proportion of women, especially the youngest age group, had intakes of micronutrients that can be considered inadequate. The proportion of men achieving low intakes was considerably lower, probably because men tend to eat more food in general and so are more likely to achieve micronutrient needs.

Similarly, data from the recently published survey of people over the age of 65 years shows that a substantial proportion have intakes of some micronutrients that fall below the LRNI¹¹. This large national survey

Table 7 Average intakes of a range of vitamins, expressed as %RNI, in subjects aged over 65 years.

	Free-living		Living in institutions	
	Men	Women	Men	Women
Vitamin A	168	161	151	160
Thiamin	166	148	149	142
Riboflavin	134	130	138	147
Niacin	200	206	170	194
Vitamin B6	168	160	154	158
Vitamin B12	404	298	329	304
Folate	135	103	117	99
Vitamin C	167	152	124	119
Vitamin D	41	29	38	33

Data from Finch *et al*¹¹

Table 8 Average intakes of a range of minerals, expressed as %RNI, in subjects aged over 65 years

	Free-living		Living in institutions	
	Men	Women	Men	Women
Iron	127	99	111	94
Calcium	119	99	136	123
Phosphorus	225	180	218	192
Magnesium	85	73	72	70
Sodium	168	128	170	138
Potassium	78	63	69	61
Zinc	93	98	88	101
Iodine	134	106	138	125

Data from Finch *et al*¹¹.

included subjects living in their own homes as well as people living in various types of residential institutions. Tables 7 and 8 show the average intakes of a range of vitamins and minerals as a proportion of the RNIs, the amounts believed to cover the needs of 97.5% of the population group to which they apply. Vitamin D intakes were particularly low and this can become clinically important if mobility and exposure to sunlight are reduced. The average folate intake (in institutionalised women) was close to the RNI. For the minerals (Table 8), average intakes of potassium and magnesium were well below the RNIs, zinc was close to the RNI and the average iron intakes of both groups of women were also close to the RNI, as were average calcium intakes in free-living women.

It is also interesting to note that, with one or two exceptions, the intakes of vitamins and minerals in the institutionalised participants were lower than those of free-living participants (though they were generally above the RNI). However, for several nutrients, namely calcium, riboflavin and vitamin A, those in institutions fared better. These three nutrients are provided by milk, and milk intake was higher in institutions than in the free-living subjects.

Although the average intakes of most nutrients were well above the RNI, a small proportion of subjects had intakes below the LRNI (the quantity sufficient for only 2.5% of the population). There is no LRNI for vitamin D; however, virtually all the subjects had intakes below the RNI (Table 9). A substantial proportion of subjects had intakes of magnesium and potassium below the LRNI (Table 10). The data in Tables 7–10 represent the picture for the group as a whole, but for those nutrients marked with an asterisk, there was evidence that the situation worsened in the older age groups.

Use of the dietary reference values in this way is immensely valuable in determining public health nutrition issues that need to be tackled within a particular population sub-group.

Table 9 Proportion of subjects over 65 years with vitamin intakes from food below the LRNI (%)

	Free-living		Living in institutions	
	Men	Women	Men	Women
Vitamin A	5	4	1	1
Thiamin	> 0.5	> 0.5	1	> 0.5
Riboflavin*	5	10	3	3
Niacin	> 0.5	> 0.5	> 0.5	> 0.5
Vitamin B6*	2	3	1	2
Vitamin B12	> 0.5	1	nil	nil
Folate*	1	6	4	5
Vitamin C*	2	2	1	nil
Vitamin D	97% below RNI		99% below RNI	

*Increases with age

Data from Finch *et al*¹¹

Bioavailability

Although a particular food may provide considerable amounts of a particular nutrient, it does not always follow that the nutrient will be available for absorption and utilisation. The efficiency with which a nutrient is used by the body is known as its bioavailability. For some nutrients (amino acids, fatty acids and other lipids, starch and sugar), bioavailability is high (90% or more). But for others, especially some minerals, bioavailability is low and poorly predicted. This is an important concept that needs to be taken into account in the calculation of DRVs for nutrients, especially those with variable bioavailabilities². For example, the absorption of iron present in the form of haem iron (*e.g.* as in meat) is considerably greater than the absorption of iron, present as ferric iron,

Table 10 Proportion of subjects over 65 years with mineral intakes from food below the LRNI (%)

	Free-living		Living in institutions	
	Men	Women	Men	Women
Iron*	1	6	5	6
Calcium	5	9	1	> 0.5
Magnesium*	21	23	39	22
Sodium	nil	nil	nil	nil
Potassium*	17	39	28	42
Zinc*	8	5	13	4
Iodine	2	6	1	1

*Increases with age

Data from Finch *et al*¹¹

from cereals and vegetables (non-haem iron). Similarly, calcium is relatively well absorbed from milk and some vegetables, *e.g.* broccoli, but very poorly absorbed from spinach. Although spinach contains plenty of calcium, this is very poorly absorbed because it remains bound within the plant's structure.

Factors that influence bioavailability include:

- 1 The chemical form of the nutrient, *e.g.* haem iron is better utilised than inorganic iron
- 2 Antagonistic ligands, *e.g.* phosphates, phytate, polyphenols, oxalates, factors in wheat bran. These bind the nutrient and reduce its availability for absorption.
- 3 Facilitatory ligands, *e.g.* ascorbic acid (aids iron absorption), some sugars, amino acids, carboxylic acids. These improve absorption.
- 4 Competitive interaction, *e.g.* copper versus iron versus zinc versus cadmium.
- 5 Bacterial fermentation in the colon can influence availability of products resulting from the fermentation of dietary fibre.
- 6 Changes in mucosal structure and function.
- 7 Anabolic requirement, *e.g.* utilisation (and proportional absorption) of some nutrients is increased in response to growth, pregnancy or lactation.
- 8 Systemic factors, such as infection, stress and catabolism.
- 9 Homeostatic setting for nutrient determined by previous (recent) dietary supply, *e.g.* iron.

Food labelling

Reference values for selected vitamins and minerals are increasingly used on food labels. In this context, they are described as RDAs and the quantities to which they are referred are usually different to the RNI established in the UK. This is because the RDAs used in food labelling are part of European food legislation and reflect the variation in opinion across Europe as to the precise value to use. Also, there is only one figure for each nutrient, derived from figures for adults, rather than a range of figures that vary with age, sex and physiological status. The labelling RDAs, like the RNI, are estimates of the amounts sufficient to meet the needs of groups rather than individuals. To aid consumers' understanding of how a particular food might fit into a balanced diet, the Institute of

Grocery Distribution has published guidelines derived from the DRVs. These concern fat and energy (calorie) intake and recommend the use on packaging of bench marks against which the fat or energy content per serving of a food can be compared¹².

Optimising nutritional status

The traditional view has been that once intake is sufficient to ensure that an individual is not deficient in a particular nutrient and that sufficient stores exist to ward off any transient increase in demand, then there is little point in increasing intake of the nutrient any further. This view is being challenged in a number of ways. One of the best known examples is that of folate. There is now firm evidence that the risk of a woman having a baby affected by spina bifida or other form of neural tube defect (NTD) is influenced by her folate/folic acid intake^{13,14}. Women who have babies affected by NTDs are not necessarily folate deficient, using traditional criteria, but the higher their folate status is, within the physiological range, the less likely they are to have an NTD affected baby¹⁵. For this reason, folic acid supplements (400 µg/day) are now recommended for all women of childbearing age¹⁶; yet the RNI is only 200 µg.

Similarly, there is growing evidence that plasma levels of homocysteine, a predictor of risk for cardiovascular disease^{17,18}, can be reduced by intakes of folic acid that are just a little above current RNIs^{19,20}. The evidence does not imply the need for megadoses in either example, the effects were seen at intakes of folate at the top of the range associated with a healthy diet.

Intense attention is being focused on the possible beneficial effects of a whole host of substances found in plants. It is now well recognised that a high consumption of fruit and vegetables is protective against conditions such as heart disease and some forms of cancer^{8,21}. However, the nature of the protective effect is yet to be fully elucidated. Although some of the substances present in such foods are already recognised as nutrients, *e.g.* vitamins C and E, carotenoids and minerals such as potassium, it may well be that in the future other factors such as specific flavonoids, *e.g.* phyto-estrogens, flavanols and flavones, will be added to the list of recognised 'nutrients'.

Translation of nutrient requirements into dietary guidelines

There is general agreement that there is a need to pop pop recommendations on nutrient intake (*e.g.* 35% energy from fat) into food-based dietary guidelines. The recent FAO/WHO²² report on the preparation of

food-based dietary guidelines identifies two key principles that should apply. The first is that dietary guidelines should be based on an existing public health problem rather than a difference between prevailing nutrient intake and some recommended ideal nutrient intake. The second principle is that food-based dietary guidelines should be developed in a cultural context, which implies that they should be derived from prevailing patterns of food intake rather than some epidemiologically based ideal. Within these guiding principles, the translation of nutrient recommendations into food-based dietary guidelines should be flexible to accommodate different levels of knowledge of prevailing food and nutrient intakes of the target group.

In Britain, expert scientific advice has been pop popd into eight general dietary guidelines: (i) enjoy your food; (ii) eat a variety of different foods; (iii) eat the right amount to be a healthy weight; (iv) eat plenty of foods rich in starch and fibre; (v) eat plenty of fruit and vegetables; (vi) do not eat too many foods that contain a lot of fat; (vii) do not have sugary foods and drinks too often; and (viii) if you drink alcohol, drink sensibly.

These form the core of the population-targeted dietary advice in the UK and are supported by a food selection guide, depicting a plate, showing the types and proportions of foods needed for a balanced and healthy diet²³. The categories represented on the 'plate' used as the basis of the food selection guide are: fruit and vegetables (33%); bread, other cereals and potatoes (33%); milk and dairy foods (15%); meat, fish and alternatives (12%); foods containing fat, foods containing sugar (8%).

To help set dietary guidelines, data from national surveys such as the Dietary and Nutritional Survey of British Adults^{12,24} can be used to identify statistically significant differences between sub-groups of the study population that met, or failed to meet, population nutritional goals for intakes of total fat, saturates and dietary fibre.

Using this technique, it was found that several patterns of eating habits, including greater consumption of starchy foods (particularly wholemeal varieties), greater consumption of fruit and the substitution of reduced fat milk for whole milk, were shared by the sub-groups that met each of the nutritional goals targeted in the study²³.

It should be noted that a major problem in examining food intake data to devise food-based dietary guidelines is that of selective under-reporting. Most dietary surveys encounter under-reporting of energy, but we know very little about which foods tend to be under-reported or whether it is frequency of intake or serving size that is under-reported.

The approach recommended by FAO/WHO²² has been used as the basis for exploring various options for food-based dietary guidelines in Ireland²⁵. Four particular approaches have been used to explore the impact of various strategies on the potential to increase the fibre intake

of Irish women. The first approach looked at whether it might be possible to get more women to eat a particular food category recognised as being a good source of fibre. The second and third focused on consumers of particular foods and asked whether the frequency of intake could be increased and whether serving size could be increased. The final strategy explored whether, within a given food category, nutrient intake could be increased by switching to a comparable alternative. It became apparent that whereas it might be possible to increase the proportion of women consuming breakfast cereals and pulses, it would not be realistic to expect this to happen with the rest of the foods identified as good sources of fibre, *e.g.* potatoes, because most women were already eating them. However, it was also apparent that it might be feasible to increase the frequency of consumption of fruit and pulses. Also, for bread and breakfast cereals, a change to higher fibre versions might prove acceptable and successful.

Using these strategies, they considered the impact on fibre intake of prevailing patterns compared with three different levels of possible change. Based on their analysis, it is apparent that it would not be feasible to increase fibre intake via potatoes, but achievement of this might be possible by promoting wholemeal bread and high fibre breakfast cereals as appropriate alternatives to lower fibre versions. Other strategies would be to increase daily fruit intake and weekly intake of pulses.

Gibney²⁵ suggests that this approach can be systematically applied to each nutrient and micronutrient and, through some appropriate modelling, be applied to the diet as a whole. Used in conjunction with other strategies, such as food patterns associated with high and low fibre intakes (as described above), it is more likely that a set of attainable and culturally acceptable guidelines on food intake will be the outcome.

Key points for clinical practice

- A set of dietary reference values exists for energy and nutrients. These relate to the needs of groups of healthy people and are designed to be met, on average, over a period of days.
- They are also of use to dietitians as a yardstick for the assessment of individuals' diets. But experience and caution is required if they are used in this way.
- If an individual is routinely consuming the RNI for a particular nutrient, it can be assumed that his or her diet provides adequate amounts. If an individual is consistently consuming less than the

LRNI, it can be assumed that his or her diet is deficient in that nutrient, although it does not imply the person is clinically ill.

- Although a particular food may provide considerable amounts of a particular nutrient, it does not always follow that the nutrient will be available for absorption and utilisation.
- The traditional view that there is no point in increasing intake of a nutrient above the amount needed to maintain moderate stores or adequate plasma levels is being challenged. One of the best known examples of this is folate.

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