Department of Health and Social Security

Report on Health and Social Subjects

15

RECOMMENDED DAILY AMOUNTS OF FOOD ENERGY AND NUTRIENTS FOR GROUPS OF PEOPLE IN THE UNITED KINGDOM

Report by the Committee on Medical Aspects of Food Policy

's Stationery Office

Helen Rose

Department of Health and Social Security

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Preface

The question "How much food or how much of a particular nutrient should one eat in order to be healthy?" is continually asked of the experts. Unfortunately the extent of present knowledge is such that no accurate quantitative answer can be given. The needs of individuals, that is to say, their requirements either for foods or for the nutrients contained in foods are different for different individuals. For most nutrients relatively little is known about the variations in individual requirements.

Nonetheless, nutrition research has produced a body of factual knowledge from which can be deduced the average amounts of food energy and of certain nutrients necessary to ensure health for a group of people. These amounts have, in the past, been called recommended allowances or recommended intakes. In this report the term *recommended amounts* of food energy and nutrients is used. The report attempts to make clearer that the amounts refer to averages for a group of people and not to amounts which each individual must eat.

In the ten years since the publication of the 1969 Report on recommendations for energy and nutrients there has been some new research work in this field. The Committee on Medical Aspects of Food Policy has re-assessed the evidence and this report summarizes the results of their deliberations in the Table of recommended amounts. The introductory part of the report explains the meaning of the recommendations and the legitimate ways in which the figures can be used. The second part gives a brief explanation of the reasons for any change in the recommendations and an indication of the research work upon which the figures are based. A full bibliography should help the reader to find the source information if he so desires.

As Chairman of the Committee, I record my thanks for the time and effort which members have given unstintingly in producing the report. A complex subject has been expressed in simple language and we are grateful for this further contribution to a difficult aspect of nutrition.

H. YELLOWLEES
Chief Medical Officer

Membership of the Committee on Medical Aspects of Food Policy

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*Department of Health and Social Security, 1969. *Recommended intakes of nutrients for the United Kingdom* (Report on Public Health and Medical Subjects No.120) London H.M.S.O.

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Purpose and use of the recommendations

Introduction

1. Ten years have elapsed since publication of the report on recommended intakes of nutrients for the United Kingdom (Department of Health and Social Security, 1969). A revision of the report, as more knowledge became available, was always envisaged. More difficulties have been encountered about the use of the figures than about their validity. Although the figures were intended to apply to groups of people, they have been used mistakenly as recommendations for individuals.

2. This report attempts to avoid any confusion between recommendations for groups of people and the requirements of an individual, and to explain more clearly the ways in which the figures can be used. The recommendations have been updated where possible. Over the past decade, however, there has been relatively little new information on the basis of which the figures should be altered. The resulting table of recommended daily amounts (Table 1) differs little from Table 1 of the 1969 report. Where there are differences in the figures, the reasons for them are explained. The relevant references are included in the bibliography.

3. In the 1969 report (paragraph 3, page 2) recommended intakes of nutrients were defined as "the amounts sufficient or more than sufficient for the nutritional needs of practically all healthy persons in a population". One interpretation of this definition has been that, in order to maintain health, each person should receive at least the recommended amount or more. In other words the amount recommended was taken to be a minimum amount.

4. This interpretation of the recommended intake for a nutrient as a minimum individual intake was strengthened by the statement in the 1969 report (paragraph 4, page 2) that the recommendations for energy differ fundamentally from those for nutrients. The recommendation for energy was defined as the *average* intake of individuals in a group, and there was no intention that every person should receive the exact amount recommended.

5. Experience has shown that the distribution of nutrient intakes in a group of healthy people is such that many individuals eat less than the amounts put forward in the 1969 recommendations without any recognizable signs of deficiency. A more practical definition of the recommended amount of a nutrient is as follows: the average amount of the nutrient which should be provided per head in a group of people if the needs of practically all members of the group are to be met.

6. In planning diets for groups of healthy people, the recommended amount should be multiplied by the number of people in the group in order to assess the

total intake of the nutrient to be provided for that group. This brings the recommended amount of a nutrient into line with the definition of a recommended amount of food energy. There is, however, an important difference, which results from the way in which recommendations are derived from estimates of requirements. In the case of energy the recommended amount for a group is identical with the estimate of the average requirement of the group (paragraphs 9–11); in the case of a nutrient the recommended amount represents a judgement of the average requirement, plus a margin of safety (paragraphs 12–18).

7. The recommendations relate to groups of healthy people. For normal adults metabolic equilibrium is assumed to exist, that is, the assumption is made that over a period of weeks neither their mean body weight nor the composition of their bodies changes. For groups of healthy people not in equilibrium, such as growing children and pregnant or lactating women, allowance is made for the needs of growth in the child, for fetal growth and for the secretion of milk.

8. The recommendations do not cover any additional needs arising from disease, such as infections, disorders of the gastro-intestinal tract or metabolic abnormalities. The recommendation for any one nutrient presupposes that those for energy and all other nutrients are fully met. The amounts recommended relate to the amount consumed: in using the figures, allowance should be made for the wastage that occurs in wholesale or retail distribution or in kitchen preparation and cooking.

Recommended amounts of food energy

9. People who are of the same age, sex and body size, and who perform the same activities at work or in leisure time, may, nevertheless, have different requirements for food energy over the 24-hour period, because energy requirement is determined by energy expenditure, and energy expenditure is not the same for all individuals. Intake must balance expenditure if the body is neither gaining nor losing weight.* The requirement, therefore, is the amount of food energy which maintains this balance. The range of food energy intakes in a group of individuals corresponds to the range of individual requirements provided that all members of the group are in balance, that is to say, neither gaining nor losing weight.

10. The recommended daily amount of food energy is equated with the estimated average requirement. This amount, multiplied by the number of people in the group of healthy individuals, gives the total quantity of food energy per day (or averaged over several days, since the requirement need not be met each day) which satisfies the requirements of the group. About one half of the individuals in the group would be expected to have intakes less than, and half more than, the recommended amounts; but in both instances the intake should satisfy the requirement of the individuals concerned provided the sharing is in accord with individual needs.

* This statement is an over-simplification because there is some adaptation both to intakes somewhat above the requirement (thermogenesis) and to intakes somewhat below the requirement. Nevertheless the statement can be taken as broadly true for the purposes of this report.

11. No addition to the requirement for energy needs to be made as a safety precaution. Any appreciable excess intake will not be disposed of but will be stored and, during the process of storage, the individual would not be in equilibrium and so would not fulfil the conditions stated in paragraph 9 above.

Recommended amounts of nutrients

12. Recommended amounts of nutrients are derived from estimates of nutrient requirements. The requirement of an individual for a nutrient is the amount needed daily to maintain health, and below which signs of deficiency might develop. Requirements differ from one individual to another and, moreover, the requirements of an individual may change with alterations in the composition and nature of the diet as a whole, because such alterations may affect the efficiency with which nutrients are absorbed or utilized.

13. The information from which estimates of requirements have been derived differs for the different nutrients, but can be listed as follows:

a. the minimum intake of a nutrient which is associated with the absence of any signs of deficiency disease within the community;
b. the minimum intake of a nutrient needed to maintain metabolic balance over a long period;
c. the minimum intake of a nutrient needed to cure clinical signs of deficiency;
d. the minimum intake needed to maintain tissue saturation.

14. In general the distribution of requirements is not known, and the recommendation has to be *judged,* on the available information about requirements to be the amount appropriate for planning diets that will maintain the health of a group of individuals. In making this judgement account must be taken, as far as possible, of the differences which can exist between individuals, and a suitable safety margin is incorporated. The amounts recommended, although they are greater than the requirements of most individuals, are not harmful. An excess intake of most nutrients is either not absorbed, or is retained in part until tissue saturation is complete, the excess then being metabolized or eliminated.

15. Intakes differ between individuals and, even if the recommendation for a group provides an adequate average amount, some individuals will eat more and some less than the average. Those who eat more than average may have a large requirement and, in theory at least, they may still not satisfy their large requirement, or they may have a small requirement and be eating more than they need. Those who eat less than the average may have a small requirement which is satisfied, or they may not be consuming enough to meet their needs. As far as is known, consumption of nutrients is not related to need.

16. The risk of not meeting requirements cannot be completely avoided since, for most nutrients, there is very little information about the range of individual requirements and in all groups there will be some subjects who consume substantially more or substantially less than the average. The recommended amounts must be large enough to reduce to a minimum the risk that some people may not get enough to meet their needs, but not so large that the amounts are impractical or uneconomic.

17. The validity of the judgement can be tested only by experience. Surveys in this and other developed countries have shown that, although for many nutrients a substantial proportion of people have intakes which are less than those recommended, objective evidence of nutritional deficiency is rare. This is the situation that would be expected if recommended amounts have been assessed realistically.

18. The recommended amounts of nutrients, as defined in paragraph 6, incorporate safety margins and also take account, as far as present knowledge allows, of the needs for growth in children; differences in requirements according to sex and age; differences in the degree of physical activity, and the additional requirements of pregnancy and lactation.

Use of recommended amounts of food energy and of nutrients

Planning food supplies

19. In general food supplies will be planned in the first instance on the basis of estimates of the energy needs of the group concerned. The composition of the diet will usually be determined mainly by considerations such as availability and acceptability of foodstuffs and the prevailing dietary pattern. In the United Kingdom, if the energy needs are satisfied, a mixed diet will then provide sufficient of most of the other nutrients. The figures in Table 1 can be used to assess whether the recommended amounts of nutrients are met and, if not, what changes in supplies should be made.

Interpretation of surveys of food supplies

20. For the assessment of the adequacy of food supplies, either on a national scale or for domestic use, the recommendations may be used as a yardstick for a comparison of the different amounts of food provided for or obtained by different socio-economic groups, and for the identification of trends in supplies. They should not be used for making judgements about nutritional status.

Evaluation of the information derived from surveys of dietary intakes

21. Recommended amounts have a limited use in the evaluation of the results of surveys of the amounts of food eaten by individuals. The figures in Table 1 are based on judgements of the available evidence (paragraph 14) and, since the distribution of requirements for nutrients is not known, it is not possible to estimate the probability that an individual is undernourished by comparing his or her intake with the recommended amount. Nevertheless, it would still be true to say that, on present knowledge, the greater the proportion of people with intakes below those recommended, the greater the possibility that some individuals may be undernourished with respect to the nutrient or nutrients in question.

22. If the nutrient intake of any individual is shown to be less than the recommended amount for that nutrient this does not necessarily imply under-

nutrition in that person. A particular individual may have a small requirement for the nutrient, which can be easily met by an intake less than that recommended. Diagnosis of undernutrition in an individual can be made only on the basis of an assessment of all relevant clinical, anthropometric, biochemical and haematological factors.

23. In summary, recommended daily amounts of food energy and of nutrients are of value in three ways:

a. for planning food supplies and diets;

b. as a yardstick in the assessment of information about food supplies by means of which differences between groups of individuals and trends in time can be described, and

c. for directing attention, in surveys of food intake of different groups, to sub-groups who may be at risk of undernutrition. The individuals within such sub-groups would then need to be examined and their nutritional status assessed by the other investigations referred to in paragraph 22 above.

Table 1 Recommended daily amounts of food energy and som

Age range[a] years	Occupational category	Energy[b] MJ	Energy[b] Kcal	Protein[d] g	Thiamin mg	Riboflavin mg
Boys						
under 1		(c)	(c)	(e)	0.3	0.4
1		5.0	1200	30	0.5	0.6
2		5.75	1400	35	0.6	0.7
3–4		6.5	1560	39	0.6	0.8
5–6		7.25	1740	43	0.7	0.9
7–8		8.25	1980	49	0.8	1.0
9–11		9.5	2280	57	0.9	1.2
12–14		11.0	2640	66	1.1	1.4
15–17		12.0	2880	72	1.2	1.7
Girls						
under 1		(c)	(c)	(e)	0.3	0.4
1		4.5	1100	27	0.4	0.6
2		5.5	1300	32	0.5	0.7
3–4		6.25	1500	37	0.6	0.8
5–6		7.0	1680	42	0.7	0.9
7–8		8.0	1900	47	0.8	1.0
9–11		8.5	2050	51	0.8	1.2
12–14		9.0	2150	53	0.9	1.4
15–17		9.0	2150	53	0.9	1.7
Men						
18–34	Sedentary	10.5	2510	63	1.0	1.6
	Moderately active	12.0	2900	72	1.2	1.6
	Very active	14.0	3350	84	1.3	1.6
35–64	Sedentary	10.0	2400	60	1.0	1.6
	Moderately active	11.5	2750	69	1.1	1.6
	Very active	14.0	3350	84	1.3	1.6
65–74 }	Assuming a	10.0	2400	60	1.0	1.6
75 + }	sedentary life	9.0	2150	54	0.9	1.6
Women						
18–54	Most occupations	9.0	2150	54	0.9	1.3
	Very active	10.5	2500	62	1.0	1.3
55–74 }	Assuming a	8.0	1900	47	0.8	1.3
75 + }	sedentary life	7.0	1680	42	0.7	1.3
Pregnancy		10.0	2400	60	1.0	1.6
Lactation		11.5	2750	69	1.1	1.8

Notes to Table 1

(a) Since the recommendations are average amounts, the figures for each age range represent the amounts recommended at the middle of the range. Within each age range, younger children will need less, and older children more, than the amount recommended.

(b) Megajoules (10^6 joules). Calculated from the relation 1 kilocalorie = 4.184 kilojoules, that is to say, 1 megajoule = 240 kilocalories.

(c) See Table 2.

(d) Recommended amounts have been calculated as 10% of the recommendations for energy (paragraph 44).

(e) See Table 2.

(f) 1 nicotinic acid equivalent = 1mg available nicotinic acid or 60mg tryptophan.

Nicotinic acid equivalents mg[f]	Ascorbic acid mg	Vitamin A retinol equivalents μg[g]	Vitamin D[h] cholecalciferol μg	Calcium mg	Iron mg
5	20	450	7.5	600	6
7	20	300	10	600	7
8	20	300	10	600	7
9	20	300	10	600	8
10	20	300	(h)	600	10
11	20	400	(h)	600	10
14	25	575	(h)	700	12
16	25	725	(h)	700	12
19	30	750	(h)	600	12
5	20	450	7.5	600	6
7	20	300	10	600	7
8	20	300	10	600	7
9	20	300	10	600	8
10	20	300	(h)	600	10
11	20	400	(h)	600	10
14	25	575	(h)	700	12[j]
16	25	725	(h)	700	12[j]
19	30	750	(h)	600	12[j]
18	30	750	(h)	500	10
18	30	750	(h)	500	10
18	30	750	(h)	500	10
18	30	750	(h)	500	10
18	30	750	(h)	500	10
18	30	750	(h)	500	10
18	30	750	(h)	500	10
18	30	750	(h)	500	10
15	30	750	(h)	500	12[j]
15	30	750		500	12[j]
15	30	750	(h)	500	10
15	30	750	(h)	500	10
18	60	750	10	1200[i]	13
21	60	1200	10	1200	15

(g) 1 retinol equivalent = 1 μg retinol or 6 μg β-carotene or 12 μg other biologically active carotenoids.

(h) No dietary sources may be necessary for children and adults who are sufficiently exposed to sunlight, but during the winter children and adolescents should receive 10 μg (400 i.u.) daily by supplementation. Adults with inadequate exposure to sunlight, for example those who are housebound, may also need a supplement of 10 μg daily (paragraph 60).

(i) For the third trimester only.

(j) This intake may not be sufficient for 10% of girls and women with large menstrual losses (paragraphs 63-70).

Doubts have been expressed about the validity of the recommended daily amounts for folate and the figures have been withdrawn from Table 1 in this reprinted edition. The Committee on Medical Aspects of Food Policy has decided that there is too little information at present upon which to base a practical recommendation for folate until further research has been done. A recommended daily amount for folate will be set as soon as sufficient information about folate requirements in the United Kingdom makes this possible (paragraphs 55-56).

Explanatory notes to Table 1

Food Energy

Measurement of energy intake

24. The unit of energy formerly used by nutritionists was the kilocalorie (kcal). In the Système International (SI) the unit of energy is the joule (J) (Royal Society, 1969). In this report energy values are therefore given first in joules. Calories are converted to joules by multiplying by 4.184 (or for practical purposes by 4.2). 1 kilocalorie (kcal) equals 4.2 kilojoules (kJ); 1000 kJ are 1 megajoule (MJ). 1 kJ equals 0.24 kcal and 1 MJ equals 240 kcal.

25. Energy intake is defined as the sum of energy provided by the available carbohydrate, fat, protein and alcohol in the food ingested, and is usually calculated by the application of the appropriate conversion factors to the amounts of energy-providing constituents in the diet (Widdowson, 1960). The factors 4 kcal/g protein, 9 kcal/g fat and 3.75 kcal/g available carbohydrate (expressed as monosaccharides) predict the energy of the diet eaten in the United Kingdom with reasonable accuracy (Southgate and Durnin, 1970). Alcohol provides 7 kcal/g.

26. In the SI system these factors are 17 kJ/g protein, 37 kJ/g fat, 16 kJ/g available carbohydrate (as monosaccharides), and 29 kJ/g alcohol (Royal Society, 1972). These figures are not the exact arithmetic equivalents of the old factors but are close to the experimental values of Southgate and Durnin (1970).

27. At the present time no quantitative estimate of the potential contribution from dietary fibre can be made, but the amount of energy is small for most diets in the United Kingdom. Organic acids, such as citric acid, in the diet may also contribute some energy, although the contribution is small and is usually ignored.

Recommended amounts of food energy for adults

28. Recommendations for food energy for adults in the 1969 report were based on values for energy expenditure or energy intake of groups of the United Kingdom population (Harries, Hobson and Hollingsworth, 1962; Durnin and Passmore, 1967). Since then there have been few new surveys. Revised recommendations, as defined in paragraph 4, are given in Table 1. The figures have mostly been rounded off to 0.5 MJ and slightly reduced in most cases. The reductions appear justified because the trend to decreased energy expenditure both at work, where the decrease is associated with increasing mechanization, and during recreation appears to be continuing.

29. In order to allow for an increased need for food energy with greater degrees of activity, men are divided into sedentary, moderately active and very active groups (Durnin and Passmore, 1967; Davidson, Passmore, Brock and Truswell,

1975). Women are divided into two groups, one of which comprises most occupations and the other very active occupations.

30. Energy needs also vary with age, and recommended amounts are set for men in four age groups after the age of 18: 18–34 years, that is to say, early adult life; 35–64 years, or middle age, when some reduction in physical activity occurs; 65–74 years when most men have retired, and 75 years and over. Similarly recommendations have been set for women in three age groups; 18–54 years; 55–74 years, and 75 years and over. The reduction in the recommended allowance for women of increasing age is small and further subdivision would be unrealistic.

Recommended amounts of food energy for infants

31. The energy requirements of infants have been assessed by measuring the voluntary intake of bottle-fed babies who are growing normally (Beal, 1970; Fomon et al, 1971). Infants differ widely in their voluntary intakes and the differences are only slightly reduced when the intakes are related to body weights. On average, boys weigh more at birth than girls and gain weight faster, so that their intakes are greater, but per unit body weight there is little difference between the intakes of the two sexes.

32. The energy requirement derived from these measurements of intake is on average about 115 kcal per kg in the first two months, decreasing to 100 kcal per kg at 4 months and remaining at this figure until the end of the first year of life. The values in Table 2, both for body weight and for energy requirement, are averages. A range of variation in energy intake between individual children of ±15% appears to be compatible with normal growth and health.

33. It is possible that the recommended amounts set in Table 2 are a little too big, since there are few reliable figures in the literature for the energy intakes of fully breast-fed infants. Calculations from the results of Lonnerdal, Forsum and Hambraeus (1976) suggest that after 1 month of age the energy intakes of breast-fed infants may be somewhat lower than those shown in Table 2.

Table 2 Recommended daily amounts (RDA) of food energy and protein for infants

Age range months	Body weight kg		RDA food energy (mean)				RDA protein g	
	Boys	Girls	MJ Boys	MJ Girls	kcal Boys	kcal Girls	Boys	Girls
0–3	4.6	4.4	2.2	2.1	530	500	13	12.5
3–6	7.1	6.6	3.0	2.8	720	670	18	17
6–9	8.8	8.2	3.7	3.4	880	810	22	20
9–12	9.8	9.0	4.1	3.8	980	910	24.5	23

Recommended amounts of food energy for children and adolescents

34. In the 1969 report recommendations were based on information from a survey of energy intakes of young children (Widdowson, 1947). The figures were in agreement with the results of other surveys (Bransby and Fothergill, 1954; Ministry of Health, 1968). Later studies (Department of Health and Social Security, 1975; Black, Billewicz and Thomson, 1976) suggest that children, like adults, now eat less than formerly, and consequently the recommended amounts for pre-school children in Table 1 have been reduced. The later surveys also indicate that the sex difference in energy intakes is characteristic not only of infants but also of older pre-school children (Black et al, 1976). Recommendations have therefore been made separately for the two sexes from infancy. A break is made at the age of five, to coincide with the start of primary schooling, which may well be associated with a change in activity.

35. The recommendations for older children of school age are based on studies by Cook. Altman, Moore, Topp and Holland (1973) and by Jacoby, Altman, Cook, Holland and Elliott (1975) on school children in Kent and by Durnin, Lonergan, Good and Ewan (1974) on children in Glasgow, and on nutrition surveys made by the Department of Health and Social Security (unpublished). These studies have all shown that energy intakes of school children are now lower than suggested by the evidence available in 1969. In the Department of Health and Social Security surveys and in those in Kent, medical assessments provided no evidence that the children were malnourished. On the contrary, the surveys showed that obesity is a problem in a proportion of children and that it is reasonable to set smaller recommended amounts for this age group.

Recommendations for pregnancy

36. Energy requirements are increased during pregnancy by the needs of the growing fetus and by adjustments to the metabolism and the body composition of the mother. Experimental observations and calculations suggest that, on average, healthy women who gain about 12.5 kg body weight, need an extra 335 MJ (80,000 kcal) for the whole of pregnancy (Hytten and Leitch, 1971). The amount is additional to the needs, on average, of non-pregnant women. However, physical activity is usually reduced during pregnancy, and therefore the extra energy needed is likely to be smaller than the figure quoted above. From the evidence available, an extra recommended allowance of 1 MJ/day (240 kcal/day) during the second and third trimester, that is to say, a total of 180 MJ (43,000 kcal) may be regarded as realistic in practice and physiologically adequate for pregnancy.

Recommendations for lactation

37. Healthy women who are breast feeding should increase their food intake sufficiently to meet the extra energy output in the milk. Physiological adjustments during pregnancy include the laying down of extra reserves of maternal fat and these reserves are used during lactation. An addition of 2.5 MJ (600 kcal) daily during lactation seems adequate and is recommended.

Sources of energy

38. Dietary protein, fat, carbohydrate and alcohol (ethanol) each provide fuels which, on oxidation, supply energy to the tissues. The composition of the mixture can vary widely. Alcohol is not an essential constituent of the diet, but minimal amounts of protein, fat and carbohydrate must be provided. Most diets in this country supply between 10% and 15% energy from protein (paragraphs 43-45).

39. Sufficient dietary fat is needed to provide essential fatty acids (e.g. linoleic acid). The physiological need for these acids is small and is only about 1% or 2% of the total energy. Dietary fats also contain some of the lipid-soluble vitamins and assist with their absorption.

40. If intakes of fat are not to provide an unduly large proportion of the total food energy, at least half of the energy should be derived from carbohydrate. Most of this should be in the form of starch, which is normally associated with other useful nutrients. A minimum daily amount of 100 g carbohydrate is desirable to prevent ketosis and to reduce loss of nitrogen for persons who are eating a restricted diet in order to lose weight.

41. Ethanol is metabolized mainly in the liver where it spares the utilization of fat and carbohydrate. Ethanol cannot be utilized as a fuel by muscle. If it is taken regularly, in addition to an adequate amount of the other fuels, obesity may result. Chronic alcoholism is associated with liver and other diseases, and with some nutrient deficiencies if foods associated with these nutrients are replaced by ethanol.

Protein

42. In the 1969 report (page 16), Table 3 set out the amounts of protein needed to meet physiological requirements. These amounts were considered necessary to cover obligatory losses of nitrogen and to provide, where appropriate, for the extra needs of growth, pregnancy and lactation. Since 1969, FAO/WHO (1973) have published a comprehensive report on protein requirements, with two additional reports (FAO/WHO 1975, 1978), which take account of more recent work. These reports provide estimates of what is called the "safe level" of protein intake for groups of people with different physiological needs. Except those for breast-fed infants, the "safe levels" proposed by FAO/WHO are substantially lower than the usual protein intakes of people in the United Kingdom.

43. A diet that provides less than 10% of total food energy as protein is likely to be unpalatable to most people in the United Kingdom and, furthermore, may be deficient in other nutrients such as easily absorbable iron, vitamin B_{12}, riboflavin, nicotinic acid, and trace elements, such as zinc, which are often found associated with protein. There is no evidence that any harm results from an intake of protein in excess of that needed to maintain nitrogen balance, nor that higher intakes confer any advantage. The recommended amounts given in Table

1 are set at an arbitrary figure of 10% of the food energy with the assumption that the mixed protein of the usual United Kingdom diet has a net protein utilization (NPU) of 75. The figures are lower than those recommended in 1969, because the recommended amounts for food energy have been slightly reduced.

44. Young infants up to the age of six months should as far as possible be breast-fed. Those who are not breast-fed receive artificial milks in which protein provides about 10% of food energy (Evans, 1978). After the introduction of a mixed diet, 10% of energy as protein will still be adequate, even though the biological value of the mixed protein may be somewhat lower than that of cows' milk.

45. Some individuals, such as some elderly people who have very small energy intakes, may need a larger proportion of dietary protein than that which provides 10% of the total food energy. The available evidence (Scrimshaw, Perera and Young, 1976; Uauy, Scrimshaw, Rand and Young, 1978) suggests that the physiological requirements of elderly people for protein are no less per kg body weight than those of younger adults. Thus a person who consumed 6.3 MJ/day (1500 kcal/day), of which 10% is derived from protein, would have a protein intake that only just met the "safe level", and with a lower intake might well be at risk of deficiency.

46. In considering the additional protein requirements for pregnancy and lactation, account must be taken of the fact that a diet which provides 10% of the energy as protein will more than cover the protein requirements for maintenance and leave a margin to spare. The 1969 report recommended an extra 5 g mixed protein per day in the last two trimesters, representing 10% of the extra energy intake. FAO/WHO (1973) recommended an additional 12.5 g per day (as protein with NPU 75). This figure was based on the nitrogen balance figures of Hytten and Leitch (1964). In view of the cumulative errors of nitrogen balances we consider it more realistic to estimate the extra requirement from the amounts of protein laid down in the fetus and maternal tissues. This amounts to about 900 g (Hytten and Leitch, 1971), or 5 g per day during the last two trimesters. An additional 6 g of mixed protein per day, equivalent to 10% of the extra energy, is therefore considered to be an adequate supplement to a diet which already provides relatively generous amounts of protein.

47. The output of protein in breast milk, calculated as total N×6.25, is seldom likely to exceed 10 g per day. An addition of 15 g mixed protein per day, again amounting to 10% of the extra energy, should cover this requirement.

48. The recommendations in this report are compared with those of FAO/WHO (1973) in Table 3. Although the additional daily amounts for pregnancy and lactation in the United Kingdom are smaller than those recommended by FAO/WHO, the total daily amounts of protein recommended for pregnant and lactating women are larger. The modest increments are more realistic and in better agreement with eating patterns in the United Kingdom, where the recommendation for the non-pregnant non-lactating adult woman is larger than that suggested by FAO/WHO (1973).

Table 3 Recommended daily amounts of mixed protein of NPU 75* for adult women during pregnancy and lactation

	FAO/WHO (1973) g	This report g
Adult woman not pregnant, not lactating	39	54
Pregnancy (2nd half)	51	60
Lactation	61	69

* See paragraph 43 page 11.

Thiamin

49. Thiamin requirements are closely related to carbohydrate intake. FAO/WHO (1967) suggested 80 μg/MJ (0.3 mg/1000 kcal) as an average requirement for thiamin. Allowance for individual differences and an increase in the average requirement by 20% as a safety margin (paragraph 18) gives a recommended amount of 96 μg thiamin/MJ (0.4 mg/1000 kcal). The recommended amounts in Table 1 have been calculated by applying the FAO/WHO figure of 96 μg thiamin/MJ to the recommended amounts of energy for the different categories of people.

Riboflavin

50. FAO/WHO (1967) related requirements for riboflavin to energy intake. However, there is no evidence that in man the requirement is increased during physical activity, and the requirement appears to be more closely correlated with resting metabolism. The recommended amount has been calculated on the basis of 240 μg/MJ (1 mg/1000 kcal) of resting metabolism, (Department of Health and Social Security 1969). Thus the recommended amount of riboflavin for adult men is 1.6 mg per day and for women 1.4 mg per day.

51. Although resting metabolism decreases with age there is little evidence that the requirements of the elderly for riboflavin are less than those of younger adults, and recommendations for riboflavin should not fall with increasing age (Table 1).

52. The recommended amount is increased to 1.6 mg per day during pregnancy and to 1.8 mg during lactation.

Nicotinic acid

53. As for riboflavin, the recommended amount of nicotinic acid is calculated in terms of resting metabolism, that is, 2.7 mg nicotinic acid equivalents/MJ or 11.3 mg/1000 kcal (Department of Health and Social Security, 1969). Thus

the daily recommendation for adult men is 18 mg nicotinic acid equivalents and for women 15 mg nicotinic acid equivalents, and is independent of activity. As with riboflavin, the recommended amount does not fall with increasing age.

54. An additional 3 mg nicotinic acid equivalents per day is recommended during pregnancy and an increase of about 6 mg nicotinic acid equivalents per day during lactation.

Folate

55. Free folate is well absorbed from the gastro-intestinal tract (about 95%) and utilized. Absorption of conjugated forms is variable, but 50% is a safe estimate for the biological availability of most forms found in foods (Butterworth, Baugh and Krumdieck, 1969; Tamura and Stokstad, 1973; Godwin and Rosenberg, 1975). Free plus conjugated folate make up total folate.

56. Human milk provides about 5μg folate/100 ml (Department of Health and Social Security, 1977) mostly in a form that is well absorbed, and 5μg/kg body weight has been estimated as the daily requirement in infancy (Sullivan, Lulby and Streiff, 1966). No information is available about the requirements of children for folate. In adults 100μg or less of folic acid have prevented or cured folate-deficient megaloblastic anaemia (Herbert, 1968) but this amount is not always sufficient to restore the serum folate concentration or to maintain it at the normal value. The requirements of healthy people are not yet established firmly enough for a recommended daily amount to be set. The requirement for folate is increased during pregnancy (Chanarin, Rothman, Ward and Perry, 1968.)

Ascorbic acid (Vitamin C)

57. The MRC Sheffield study (Bartley, Krebs and O'Brien, 1953) showed that a daily intake of about 10 mg ascorbic acid can prevent or cure overt signs of experimental scurvy in adults. This finding agreed with the results of studies on the utilization of radioactive ascorbic acid by healthy men (Baker, Hodges, Hood, Sauberlich and March, 1969; Hodges, Hood, Canham, Sauberlich and Baker, 1971).

58. In the United Kingdom recommendations for ascorbic acid are still based on an amount sufficient to prevent signs of deficiency, with an added safety margin, in contrast to other countries where tissue saturation is advocated. The MRC report (Bartley, Krebs and O'Brien, 1953) recommended 30 mg as including a reasonable safety margin for adults. The available data provide no reason to alter this recommendation, or to make any change in it for sex, for differences in physical activity or increasing age.

59. The recommended amounts for children are shown in Table 1. Human milk provides 3 mg to 4.5 mg ascorbic acid/100 ml (Department of Health and Social Security, 1977), or about 20 mg daily when the diet of the mother is adequate (FAO/WHO, 1970). Among breast-fed infants scurvy is unknown.

A recommended amount for artificially fed infants of 20 mg daily should cover their requirements with a reasonable safety margin.

60. The recommendation for adults should be increased to 60 mg daily during pregnancy and lactation. (Table 1).

Vitamin A

61. The recommendations in Table 1 are based on those of FAO/WHO (1967).

Vitamin D

62. The chief source of vitamin D is not the diet but the action of ultra-violet light on the skin. The amount of the vitamin obtained in this way varies with latitude and environmental conditions and cannot at present be assessed. It is difficult therefore to recommend an amount to be provided in the diet. Nevertheless, vitamin D is included in Table 1 because the intake of vitamin D from food or from vitamin supplements is a safeguard when exposure to sunlight is insufficient for the synthesis of enough vitamin D for health. For infants the amount recommended is 7.5 μg per day. No dietary sources may be necessary for children and adults who are sufficiently exposed to sunlight but, during the winter, children and adolescents should receive 10 μg daily by supplementation. Adults with inadequate exposure to sunlight, for example those who are housebound, may also need a supplement of 10 μg daily. In pregnancy and lactation the recommended amount of vitamin D is increased to 10 μg daily, especially during the winter. This amount can be achieved only by supplementation.

Calcium

63. After careful consideration of the evidence no change has been made in the recommendation for adults. This remains at 500 mg per day, which is the upper figure in the range recommended by FAO/WHO (1962). Similarly, the recommendations for calcium during pregnancy and lactation remain the same as those of FAO/WHO (1962).

64. For children between one and nine years, when the bones show a greater increase in concentration of calcium than at any other time during the growth period (Holmes, 1945; Leitch and Aitkin, 1959; Dickerson, 1962), the recommended amount has been increased to 600 mg per day, which is the same as the amount recommended between birth and one year.

Iron

65. Food in the United Kingdom provides between 1.1 mg and 1.3 mg iron/MJ and to suggest that food should provide more than 1.3 mg iron/MJ would not be practical. The amount of iron absorbed from the food depends upon the sources of iron and the composition of the diet. Haem iron from animal sources is better absorbed than inorganic iron from vegetable sources. The absorption of inorganic iron is improved by the presence of animal protein and vitamin C, and impaired by phytic acid. On the basis of the findings over the last 10 years,

there is no need to depart from the estimate given in the 1969 report (page 31) that, on average, about 10% of the iron in the British diet is absorbed.

66. For men the recommended amount of iron is 10 mg per day, and a diet which contained 1.3 mg iron/MJ would supply at least this amount for adult men at all ages and all degrees of activity. In the case of active men with high energy intakes there is no need for the additional foods which supply the extra energy to be rich in iron.

67. For women who are past child-bearing age, physiological requirements for iron do not theoretically exceed 8 mg per day. However, the recommendation is set at 10 mg per day in order to make up for possible previous iron depletion. Food which contained 1.3 mg iron/MJ would provide this amount if the diet satisfied the recommended amounts for energy for women of this age.

68. A recommendation of 12 mg iron per day is made for menstruating women. This would be supplied by a diet which satisfies the recommendation for energy and would meet the needs of all women of this age group except about 10% who have large menstrual losses (FAO/WHO, 1970). Women with excessive menstrual losses and anaemia should be identified by the health services and treated by daily administration of medicinal iron.

69. The recommended daily amount of food energy is increased during pregnancy from 9 to 10 MJ during the second and third trimesters (paragraph 38). If the proportion of iron in the diet is unchanged the amount of dietary iron would increase from 11.7 mg to 13.0 mg per day. This would often be sufficient, but some women become anaemic and need medicinal supplements of iron.

70. The loss of iron during lactation is rather less than the usual menstrual loss and, in most cases, can be made good by a diet containing 1.3 mg iron/MJ. But the recommended amount of energy is increased to 11.5 MJ during lactation, so that food which contained 1.3 mg iron/MJ would supply 15 mg, which is the amount recommended.

71. Provided that the iron status of the mother during pregnancy is satisfactory, the infant is born with stores of iron in the body which together with the iron present in human milk, can satisfy iron requirements for the first 4 to 6 months of life. At this age supplementary feeding is usually begun and the increased iron requirements should be adequately met.

72. Experience indicates that if children consume diets providing 1.3 mg iron/MJ they are unlikely to become anaemic and their iron requirements are met. The recommended amount for adolescent boys and girls should be 12 mg daily, that is to say, greater for boys than for adult men to allow for growth, and for girls the same as for women aged 18-55 years to allow for menstrual loss.

Other nutrients (not included in Table 1)

73. These include the vitamins B_6, B_{12}, pantothenic acid, biotin, vitamin E, vitamin K, and the inorganic nutrients magnesium, potassium, sodium, chloride, chromium, cobalt, copper, iodine, manganese, molybdenum, phosphorus, selenium and zinc, all of which are essential for human health.

74. Deficiency of these vitamins and minerals is either rare, or associated with certain medical conditions, or has not been described or confirmed in man in the United Kingdom. With the exception of vitamin B_{12}, which is found almost entirely only in foods of animal origin, these other nutrients occur in sufficient quantity in a large number of foods. Therefore in the light of present knowledge and in the context of the United Kingdom diet, recommended amounts for these nutrients have not been set.

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Other nutrients (not included in Table 1)

VITAMINS

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