Recommended Dietary Allowances

EIGHTH EDITION 1974

National Academy of Sciences

RECOMMENDED DIETARY ALLOWANCES

EIGHTH REVISED EDITION, 1974

Committee on Dietary Allowances
Committee on Interpretation of the Recommended Dietary Allowances

FOOD AND NUTRITION BOARD
National Research Council

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GENERAL CONSIDERATIONS

WHAT ARE RECOMMENDED DIETARY ALLOWANCES?

The first edition of *Recommended Dietary Allowances,* published in 1943 with the objective of "providing standards to serve as a goal for good nutrition," defined "in accordance with newer information the recommended daily allowances for the various dietary essentials for people of different ages" (FNB, 1943). A major objective of the Food and Nutrition Board of the National Research Council continues to be to encourage the development of food use practices by the population of the United States that will allow for maximum dividends in the maintenance and promotion of health (FNB, 1968). Health is defined, according to the World Health Organization, as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (Anon., 1970).

The origin of RDA* has been described in detail by the chairman of the first Committee on Recommended Dietary Allowances (Roberts, 1958). The initial publication has been revised at regular intervals since then (Miller and Voris, 1969), this being the eighth edition. From their original function as a guide for advising "on nutrition problems in connection with national defense," RDA have come to serve in other areas as a guide: for planning and procuring food supplies for population

* Recommended Dietary Allowances (RDA) should not be confused with United States Recommended Daily Allowances (USRDA), a set of values derived from RDA by the Food and Drug Administration as standards for nutritional labeling.

groups; for interpreting food consumption records; for establishing standards for public assistance programs; for evaluating the adequacy of food supplies in meeting national nutritional needs; for developing nutrition education programs; for the development of new products by industry; and for establishing guidelines for nutritional labeling of foods. As our concept of health is broadened and as the uses of RDA continue to expand, it becomes ever more critical that their meaning and limitations be clearly understood (Hegsted, 1972).

The Recommended Dietary Allowances are the levels of intake of essential nutrients considered, in the judgment of the Food and Nutrition Board on the basis of available scientific knowledge, to be adequate to meet the known nutritional needs of practically all healthy persons.

Diets Are More than Combinations of Nutrients

Use of the term "Recommended Dietary Allowances" to describe these estimates of acceptable daily intakes has some unfortunate connotations, for to many people it implies that all that is necessary to formulate an ideal diet is to ensure that the nutrient content of their daily food ration meets the RDA standard. While a diet made up of ordinary foods meeting the RDA standard should maintain health, we are well aware that present knowledge of nutritional needs is incomplete. Requirements of man for many nutrients have not been established. The essentiality of several nutrients has been established only within the past few years. Also, research continues to provide new information about the relationship between nutrition and resistance to infection and stress, to cite just two problems under active investigation. Therefore, to ensure that possibly unrecognized nutritional needs are met, RDA *should be provided from as varied a selection of foods as is practicable.*

In addition to being a source of nutrients, food has psychological and social values that are difficult to quantify. Diets of various types, some of which are not desirable by United States criteria, can be devised to meet presently recognized nutritional needs; however, as food has no nutritional value unless and until it is eaten, RDA *should be provided from a selection of foods that are acceptable and palatable.* The quantities of some nutrients recommended as adequate are less than the amounts regularly consumed and considered highly desirable by the majority of the United States population. There is much more to

consider in formulating and evaluating diets than mere computation of the amounts of nutrients needed to meet the RDA standard.

RDA *Are Recommended Intakes of Nutrients*

RDA are recommendations for the amounts of nutrients that should be consumed daily. They are neither estimates of the amounts of nutrients needed per capita in the national or local food supply, nor even in the food purchased. Thus, losses of nutrients that occur during the processing and preparation of food should be taken into consideration in planning diets based on tables of food composition.

RDA *should not be confused with requirements.* Differences in the nutrient requirements of individuals that derive from differences in their genetic makeup are ordinarily unknown. Therefore, as there is no way of predicting whose needs are high and whose are low, RDA (except for energy) are estimated to exceed the requirements of most individuals, and thereby ensure that the needs of nearly all are met.

RDA *Do Not Cover Therapeutic Nutritional Needs*

RDA are intakes of nutrients that meet the needs of healthy people and do not take into account special needs arising from infections, metabolic disorders, chronic diseases, or other abnormalities that require special dietary treatment. These must be considered as unique clinical problems that require individual attention. The nutritional needs of the premature infant are also considered to fall in this category.

Continued use of certain pharmaceutical preparations such as oral contraceptives may also influence specific nutritional needs. RDA are not formulated to cover these effects. They, too, must be considered as special problems; attention is drawn to certain of them in the sections on individual nutrients.

It cannot be emphasized too strongly that, although there are ardent proponents of ingesting excessive amounts of several individual nutrients, *we are aware of no convincing evidence of unique health benefits accruing from consumption of a large excess of any one nutrient.* Large doses of individual nutrients may have some pharmacologic action, but such effects are unrelated to nutritional function. Claims that large intakes of individual nutrients will cure nonnutritional diseases should

be viewed with skepticism since they can encourage delay in the diagnosis and treatment of diseases and symptoms that should have prompt and appropriate medical attention.

How Are Allowances Expressed?

Nutritional requirements differ among individuals, and from time to time for a given individual. They differ with age, sex, body size, physiological state, and genetic makeup. Some are further influenced by how active a person is and by the environment in which he lives. Many of these factors are taken into account by presenting allowances for various age and sex groups. Individual differences in requirements due to differences in genetic makeup are taken into account in setting the allowances. However, in order to keep the total number of allowances within manageable proportions, rather broad age and weight groups have been used and modifications required under special circumstances have not been listed in the summary table. It may, therefore, be necessary to adjust the allowances for unique population groups on the basis of information given in the text.

Age–Weight–Sex Groups The age–weight–sex groups in the table of allowances (*follows* p. 128) are based on the knowledge that requirements for most nutrients vary with body size and that requirements per unit of body weight are greater during periods of rapid growth and during pregnancy and lactation than they are for maintenance.

The age groups after the first year are given in 3- or 4-year intervals. Up to age 10 no distinction is made between the sexes, as weight ranges are little different for males and females up to this age. The age groups are given in whole numbers and the numbers do not overlap, e.g., 1–3, 4–6. The age group 1–3 thus includes children from age one to age four less one day and so on. A table of heights and weights indicates the ranges that may be encountered in each age group (Table 1). The heights and weights given for each age group have been calculated by averaging the values for the fiftieth percentile of each year included in the group, e.g., in the 1–3 age group the heights and weights represent the averages of the midpoint values for the one-, two-, and three-year-olds.

Beyond age 10, males and females are listed separately in the table of allowances. The groupings have been selected to simplify calculation of nutrient needs for school and college age groups even though there is little reason, nutritionally, to distinguish between the 19–22-year-old group and the adult.

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Basis for Expression of Allowances Requirements for nutrients may be related to different aspects of body function: The need for thiamin depends upon energy expenditure and is influenced by carbohydrate intake; the need for protein and minerals appears to be most closely related to lean body weight; the need for riboflavin has previously been related to a power function of body weight ($W^{3/4}$, considered to be related to active metabolic mass). Despite these relationships, which may differ from nutrient to nutrient, the allowances given in the table of allowances are based on body weight in order to simplify calculation. Such errors as result from this are not considered to be significant.

Allowances may be calculated for weight groups falling between those listed, on the assumption that they are proportional to body weight. For adults, adjustments are not required for small weight differences. Allowances for obese adults should be made on the basis of desirable weight for height, and for obese children on the basis of height and age, as requirements for these groups are more closely related to lean body mass than to total body weight.

How Are Allowances Estimated?

The ideal method, rarely if ever achieved, to develop an allowance would be to (1) determine the average requirement of a healthy and representative segment of each age group for the nutrient under consideration; (2) assess statistically the variability among the individuals within the group; and (3) calculate from this the amount by which the average requirement must be increased to meet the needs of nearly all healthy individuals.

The starting point for developing nutrient allowances is the scientific evidence of nutrient requirements judged by the Committee on Dietary Allowances to be most reliable. Unfortunately, experiments on man are costly, they must often be of long duration, certain types of experiments are not possible for ethical reasons, and, even under the best conditions, only a small number of subjects can be studied in a single experiment. Thus, requirement estimates must often be derived from limited information. For some nutrients the requirement must be assessed largely from one or two experimental trials on a small number of subjects; for some there are so few experiments on human subjects that requirements must be estimated either from information about the requirements of other mammals or from information about the minimum amount of the nutrient known, from food analyses and dietary surveys, to be consumed by apparently healthy people.

TABLE 1 Percentiles for Weight and Height of Males and Females Aged 0–18 Years[a]

	Males						Females					
	Body weight (kg)			Height (cm)			Body weight (kg)			Height (cm)		
Age	3	50	97	3	50	97	3	50	97	3	50	97
(months)												
< 3	3.72	4.56	6.01	51.55	55.50	59.15	3.54	4.49	5.51	51.45	54.85	58.35
3–5	5.58	6.65	8.44	59.90	63.40	67.05	5.10	6.44	7.92	58.45	62.35	65.95
6–8	6.94	8.32	10.25	65.35	68.80	73.15	6.30	7.98	10.02	63.25	67.65	71.45
9–11	7.96	9.57	11.72	69.50	73.20	78.10	7.24	9.23	11.64	67.15	72.15	76.45
(years)												
1	9.57	11.43	14.29	77.50	81.80	88.20	8.80	11.11	14.02	74.90	80.90	86.70
2	11.43	13.61	16.78	86.90	92.10	99.50	10.70	13.43	17.33	84.50	91.40	98.70
3	12.93	15.56	18.82	94.30	99.80	106.50	12.47	15.38	20.55	92.00	99.50	108.00
4	14.33	17.42	21.50	100.60	106.70	114.30	13.98	17.46	23.09	98.10	106.80	116.20
5	16.56	20.68	25.92	105.30	114.40	122.85	16.08	19.96	25.06	105.30	112.80	121.70

6	18.48	23.22	29.71	111.25	120.80	129.80	17.30	22.41	28.58	111.00	119.10	128.55
7	20.64	25.90	33.86	116.80	127.10	136.80	19.64	25.04	33.16	116.55	125.20	134.55
8	22.79	28.62	38.38	121.90	132.80	142.75	21.41	27.67	38.28	121.35	130.50	140.40
9	24.78	31.30	43.04	126.45	137.90	147.80	23.20	30.44	43.50	125.65	135.80	146.35
10	26.90	33.93	48.02	131.05	142.30	152.35	25.20	33.79	48.72	130.00	141.70	153.35
11	29.26	36.74	53.50	135.75	146.90	158.15	27.56	37.74	54.56	135.05	148.10	161.00
12	31.57	40.23	59.47	140.15	152.30	165.70	30.80	42.37	61.24	140.75	154.30	166.50
13	34.43	45.50	65.46	144.30	158.90	173.30	35.22	47.04	66.48	145.95	158.40	169.55
14	38.80	51.66	70.80	149.05	165.30	180.90	39.03	50.35	69.40	149.20	160.40	171.15
15	44.16	56.65	75.32	154.10	169.70	183.70	41.00	52.30	70.96	150.50	161.70	171.80
16	48.51	60.33	78.50	157.75	172.70	186.10	42.12	53.57	71.94	150.90	162.40	172.10
17	50.69	62.41	80.42	159.30	174.10	187.10	42.73	54.20	72.62	151.00	162.50	172.00

[a] The reference weights and heights for adults used in this report are, for males, 70 kg and 172 cm; for females 58 kg and 162 cm.

The data in this table have been used to derive weight and height reference points in the present report; it is not intended that they be considered standards of normal growth and development. The table is taken from W. E. Nelson, V. C. Vaughan, and R. J. McKay (1969) *Textbook of pediatrics*, 9th edition, Saunders, Philadelphia. The values represent the heights and weights at the midpoint age of the specified interval. For ages below one year, the values are extrapolated from data in the original sources; for all other ages they are read directly. The authors identify these data as being derived from the Harvard growth studies up to the age of 5 years and from the Iowa growth studies beyond that age.

There is not always agreement as to the basis for determining when the requirement has been met (Arroyave, 1971). The requirement for a nutrient is the minimum intake that will maintain normal function and health. The requirement for infants and children may be equated with the amount that will maintain a satisfactory rate of growth; for an adult, with the amount that will maintain body weight and prevent depletion of the nutrient from the body, as judged by balance studies or maintenance of acceptable blood and tissue concentrations. For certain nutrients the requirements may be assessed as the amount that will just prevent failure of a specific function or the development of specific deficiency signs—an amount that may differ greatly from that required to maintain maximum body stores. Thus, there are differences of opinion as to the criteria that should be used to establish requirements.

*The Allowance for Energy** The allowance for energy is treated differently from allowances for specific nutrients. Energy intake is usually well-regulated by the amount of energy expended, so long as an adequate supply of acceptable food is available and energy expenditure is great enough to ensure that mechanisms regulating food intake are functioning efficiently. Thus, there is a close relationship between the energy needs of an individual and his energy consumption. Any surplus of energy absorbed is stored as fat. Continued excessive intake of energy leads to obesity and is detrimental to health. Recommended allowances for energy are, therefore, estimates of the *average needs of population groups, not recommended intakes for individuals.* A procedure for estimating the energy need of an individual is described in the section on energy (p. 25*ff*).

Estimation of Allowances Other than That for Energy The starting point for developing a recommended allowance is—insofar as is possible—the available estimates of the average requirement and of the variability among the population studied. A logical approach in estimating a recommended allowance for nutrients other than energy is to increase the average requirement by twice the standard deviation since, with a statistically normal distribution for the requirements of individuals, 97.5 percent of the population should have requirements below this amount. The coefficients of variation (standard deviation/mean) of

* This represents an allowance for substances that can be readily oxidized by the body to yield energy.

requirements for different nutrients differ, so the percent increase in the requirement to allow for individual variability is not uniform. Unfortunately, this method cannot be applied effectively for many nutrients because there is inadequate information about the variability of individual requirements.

Since allowances other than that for energy are recommended amounts of nutrients that must be *consumed* in order to ensure that the requirements of most people are met, it is necessary to take into account any factor that influences the efficiency of nutrient utilization in setting these allowances. For some nutrients, a part of the requirement may be met by a precursor that is converted to the essential nutrient within the body. Some carotenes, for example, are precursors of vitamin A; therefore, when carotenes are included as a vitamin A source, allowance is made for efficiency of conversion of these precursors. For some nutrients, requirements are expressed in terms of a single constituent, whereas the requirement is actually for a composite of several constituents that may differ in efficiency of utilization. Protein intake, for example, is estimated in terms of nitrogen, not specific amino acids; therefore, inefficient utilization of the mixture of amino acids in the protein ingested is taken into account in developing protein allowances. For some nutrients, absorption may be incomplete; allowance must, therefore, be made for failure of a proportion of the ingested nutrient to gain entrance to the body. Only a small fraction of the iron in foods is absorbed, for example, and this is taken into consideration in developing the recommended allowances.

As the importance of each of these factors differs from nutrient to nutrient, the extent to which the allowances for different nutrients must exceed the requirement varies considerably.

With limited information about requirements, about the variability of requirements, and about factors that influence the utilization of ingested nutrients, allowances for many nutrients cannot be estimated directly from the available scientific knowledge; judgment must be invoked in interpreting and extrapolating from the available information.

It is necessary to recognize these problems in order to understand why recommendations for nutrient allowances may differ from country to country and why the allowances for some nutrients exceed the presumed requirement by a much greater proportion than those for others. On the whole, those who accept responsibility for estimating allowances tend to err on the positive side, for there is little evidence that small surpluses of nutrients are detrimental; deficits, even small ones, will, on the other hand, lead to deficiencies over a long period of time.

Adaptation, Body Stores, and Daily Allowances

The body is a highly adaptive system, having regulatory mechanisms that tend to conserve essential nutrients when the dietary supply is inadequate. The body has the capacity, evidenced particularly during periods of starvation, to conserve energy through reduced activity and lowered metabolic rate. Also, essential constituents released during the breakdown of tissues may be redistributed and reutilized to maintain the organs and tissues that are most critical. This adaptability of the body enables individuals to function well during short periods of deprivation.

In addition to having regulatory mechanisms that tend to conserve essential nutrients when intake is inadquate, the body has the ability to store some nutrients when the amounts consumed exceed immediate needs. An individual who has had a high intake of vitamin A may have stored enough of this vitamin to meet his needs for several weeks. The water-soluble vitamins are not stored to nearly the same extent. Further, inadequate intake of certain amino acids for a single day will result in negative nitrogen balance within that day. The capacity of storage mechanisms thus varies greatly for different nutrients, so it is not possible to generalize about them.

RDA are presented as daily allowances in order to simplify calculations of nutritional needs. Nevertheless, the various protective mechanisms of the body are such that, if the recommended dietary allowance for a nutrient is not met on a particular day, a surplus consumed shortly thereafter will compensate for the inadequacy. It would seem entirely acceptable, in estimating dietary adequacy, to average intakes of nutrients over a 5–8-day period. However, if nutrient intake is insufficient to meet requirements for a prolonged period, the ability to respond to stress is lessened, and depletion and deterioration eventually occur—despite the effectiveness of the various mechanisms that prolong survival.

Conditions That May Require Adjustment in Allowance

Physiological State As energy needs of infants and children per unit of body weight are 2–3 times those of adults, and since energy requirements are elevated during pregnancy and lactation, the normal increase in food intake in response to elevated energy expenditure under these conditions results in greater intakes of all nutrients, provided foods are well-selected. There is, therefore, little need for special foods or routine supplements (except possibly for iron) to ensure meeting the

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