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Editorial

The need for national nutritional goals and dietary guidelines

A number of the industrialized countries have developed dietary guidelines for health, and several have produced excellent background documents giving the evidence for their recommendations. In this issue we are publishing a translation of the dietary goals for health in Latin America published in a current special issue of *Archivos Latinoamericanos de la Nutrición*, together with suggestions for developing national guidelines based on these goals. The issue will include fourteen chapters providing an analysis of the data on which nutritional goals and suggested dietary guidelines are based.

The nutritional goals proposed for the Latin American countries have universal application for rich and poor alike, but the diets to achieve these goals will differ greatly among and within these countries. The publication *Healthy Nutrition*, issued by the WHO Regional Office for Europe [1], which is reviewed in this issue, proposes similar dietary goals and presents the background for them.

Both the Latin American and European publications are based largely on prior WHO recommendations. They provide suggestions to governments for translating the nutritional goals into food goals and eventually into dietary guidelines relevant to their own dietary and cultural traditions, while taking into account economic and other constraints on the provision of food. Both stress that a coherent food policy, taking prevention into account, involves joint action by ministries of health, agriculture, food, education, industry, and economics if benefits to health are to be achieved with the use of local food production.

The United Nations University programme in Food and Nutrition has assigned a high priority to promoting the development in every country of dietary guidelines for health that are culturally acceptable and economically feasible. In the past year comprehensive reports have also been published by Australia [2] and the United States [3]. These publications will be helpful to countries in other regions for developing dietary guidelines to meet the needs of their own populations

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Nutritional goals for health in Latin America

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This is a translation from the Spanish of the first part of the report "Guías de alimentación: Bases para su desarrollo en América Latina" by the same authors, based on a workshop on that topic held in Caracas, Venezuela, 22–28 November 1987, sponsored jointly by the United Nations University and the Fundación Cavendes [1].

This first part of the report is concerned with quantitative nutritional goals that should be useful for nutritionists and health professionals in all countries. The second part, not presented here, gives suggestions for expressing these goals in terms of dietary guidelines adapted to the food availability and preferences of individual countries and populations in Latin America. The entire report, with sixteen background papers covering every major area of the nutritional goals and their rationale, is being published in Spanish as a special issue of Archivos Latinoamericanos de la Nutrición.

Definitions

The terms "requirements," "needs," "recommendations," "goals," and "guidelines" are often used in different ways in relation to nutrition and consumption in different contexts. For the purposes of this report the following definitions are accepted.

Nutritional requirements: These are the quantities of energy and bioavailable nutrients in the foods that healthy individuals must eat to meet all of their physiological needs. By "bioavailable" is meant that they are digested, absorbed, and utilized by the organism. The nutritional requirements are individual physiological values that are expressed as averages for similar population groups—e.g. preschool children, adolescent males, pregnant women, and adult males with a determined physical activity.

Nutritional recommendations: These are the quantities of energy and nutrients that the foods consumed must contain to meet the requirements of almost all the individuals in a healthy population. They are based on requirement figures, corrected for bioavailability, to which the necessary quantity to cover the variability of the individual is added and, for some nutrients, an additional quantity is included as a margin of security.

Minimum and maximum limits exist for energy and nutrients outside of which the functioning of the organism and health are unfavourably affected.

Nutritional goals: These are the nutritional recommendations adjusted to a particular population for the purpose of promoting health, controlling deficiencies or excesses, and minimizing the risk of diseases related to nutrition. Furthermore, they take into consideration the sources of energy and nutrients, the proportions in which they are consumed, and the factors that affect their availability and consumption.

Nutritional guidelines: These are indications of practical ways to reach the nutritional goals of a given population. They are based on the habitual diet of the population and suggest necessary modifications. They take into consideration ecological, economic, social, and cultural characteristics of the population and its biological and physical environment.

Nutritional guidelines should be established for the total population of a country or region and also for special groups within that population with specific needs (e.g. young children) and for those at high risk for health problems related to nutrition (e.g. obesity).

Nutritional goals

General considerations

To establish nutritional goals, the recommendations of energy and nutrients that have been proposed by

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other organizations and international groups of experts were used as a basis. Those proposals were interpreted in light of recent scientific information and on the basis of the specific characteristics of Latin American populations.

The nutritional goals for a population permit the recommendation of diets adequate in quality and quantity to meet the needs of the members of that population and to enable them to reach and maintain a good state of health. In this sense the goals should take on a preventive nature to avoid or reduce the incidence of diseases associated with poor nutritional practices. In order to establish these goals for Latin America, the following factors must be considered.

Prevailing nutritional and health conditions

In the majority of Latin American countries there are numerous children with malnutrition and retarded growth and development, and adults whose physical activity is limited by lack of enough calories. Both situations are due to insufficient and inadequate nutrition. This is aggravated by a high incidence of diarrhoeal diseases and other infections. To these deficiencies are added nutritional anaemias and, in some populations, endemic goitre, vitamin-A deficiency, and other diseases of deprivation. Consequently, the diet must allow for the correction of these nutritional problems and compensate for the losses of and increased metabolic needs for various nutrients caused by infections.

In addition, in various sectors of the population an increase can be observed in the prevalence of diseases associated with nutritional excesses and the disproportional consumption of nutrients—such as obesity, diabetes, hypertension, and arteriosclerosis.

Heterogeneity of the population

In all Latin American countries there are urban concentrations and dispersed rural populations, with different habits and availability of foods according to their ecological circumstances. The diversity of socioeconomic and cultural conditions and levels of education also influences nutritional practices. Therefore, it is necessary to used different criteria and strategies to establish nutritional goals that will satisfy all or the great majority of the population. Nutrition and health education will play a fundamental role in those strategies.

Groups vulnerable or at risk

In all populations there are groups of individuals who are more vulnerable than others to nutritional diseases because of their age or physical state. In Latin America, furthermore, there are population groups that are at greater risk of having nutritional problems due to the socio-economic and cultural conditions in which they live. The problems are primarily those of deficiency in marginal urban areas and dispersed rural areas, while among urban groups of higher economic strata problems due to excess consumption predominate. These should all be taken into account in formulating the guidelines for attaining the nutritional goals.

Characteristics of diets

Large sectors of the rural Latin American population eat principally foods of vegetable origin. Diets based on these foods are very bulky and have a low concentration of various nutrients. Furthermore, the digestibility and/or bioavailability of some nutrients is less than in diets with a greater proportion of foods of animal origin such as are consumed by other population groups, which have advantages in nutrient content though they increase the risk of some chronic diseases.

Interactions between components of diet

A great number of interactions between components of diet have been described. Although many of them have been demonstrated only under experimental conditions, others can have practical importance in Latin American diets. Nutritional practices that lead to interactions with a beneficial effect, such as including foods with vitamin C and foods with iron in the same meal to increase the absorption of iron, should be promoted. On the other hand, combinations of foods with components that have undesirable interactions, such as tea along with sources of iron and zinc, should be avoided. This is expecially important when the diet contains small or marginal amounts of those minerals.

Quantitative expressions

The nutritional goals should be expressed in adequate qualitative and quantitative terms. The qualitative aspects should consider the biological form of the nutrients, their natural sources, and the advantage of simultaneous or isolated consumption of two or more nutrients. The quantitative aspects include the quantities of nutrients and proportions of their sources to permit good nutrition.

It is advantageous to express quantities in a uniform way and to consider the family as a basic unit of consumption. This can be done if the following points are kept in mind: (a) each family member must be able to consume enough food to obtain all the nutrients needed, and (b) the diet must satisfy both the energy needs of the individuals and also their needs for other nutrients.

The first step, then, is to determine the quantities and concentration of energy that the diet needs to supply. The concentration of food energy should be high in the diets of young children, whose stomach capacity limits the amount of food they can eat. This is perhaps also true for the elderly, whose reduction in appetite can limit the amount of food they eat.

Once the quantity and concentration of energy in the diet are established, recommendations for the majority of nutrients can be expressed as functions of that energy—for example, quantities for each 1,000 kcal. This is consistent with the idea of establishing nutritional guidelines that use the family as the basic unit of consumption. On the principle that "the whole family eats from the same pot," it is most practical to recommend a balanced diet containing concentrations of nutrients that meet the requirements of each family member when they eat enough to meet their energy needs. Nursing children, obviously, need special nutrition.

It should be recognized that for almost all the nutrients there exist limits of adequacy and for some nutrients there can be risks from either low or high consumption. For these nutrients, the nutritional goals should express the minimum and maximum levels that are safe for the population. When the maximum limit is so high that it cannot be exceeded when consuming a common diet, it need not be mentioned. On the other hand, there are some nutrients that are not absolutely indispensable but that it is advisable to consume a certain amount of (for example, proteins of animal origin); in these cases, a minimum consumption is suggested.

The recommended allowances are expressed as daily intakes. However, this does not mean that the cited quantities should necessarily be consumed every day of the week but rather that they are quantities that should be consumed as a daily average, permitting some variability between one day and the next on the basis of body reserves and transitory metabolic adjustments. The magnitude of this variability and the period of time on which the average intake is based will depend on the nutrient in question.

Tables of food composition

For the correct interpretation of the goals and the implementation of guidelines, it is necessary to have tables of food composition that are complete and dependable. The tables presently available for Latin American countries need to be revised and updated, particularly with reference to dietary fibre and various micronutrients.

Energy

As a point of departure, the workshop accepted the recommendations made by a joint FAO/WHO/UNU expert consultation in 1985 [2]. These establish that the energy needs of individuals are the amount of food energy required to compensate for energy expenditure when their size, body composition, and level of physical activity are compatible with a lasting state of good health and the maintenance of physical activity that is economically necessary and socially desirable. In children and pregnant or lactating women, the energy needs include, furthermore, those for the formation of tissues or the secretion of milk in a rhythm compatible with good health.

The FAO/WHO/UNU report also recommended that those energy needs should be calculated as multiples of basal metabolism, taking into consideration the age and sex of the individual. Within practical limits the requirements for food energy are expressed as energy units (calories or joules) per day or per unit of body weight per day, based on the basal metabolic rate, the level of physical activity, and the growth needs of the individual.

The energy requirement also depends on the activity that individuals need and that the environment and society impose. This obviously differs among different population groups of the same country. Therefore, it is not appropriate to designate persons of reference for all of Latin America or even for a whole country. Each population group has its own energy needs that depend on a series of factors that include the nature of its members' work, their volunteer and recreational social and community activities, their body mass, their physical state, the physical environment, etc. It is suggested that at the level of each country or population, the most characteristic types be established which will permit calculation in order to plan specific actions or programmes in that country or population.

Accommodation and adaptation

Humans have the capacity to modify their metabolic functions and their conduct in response to changes in energy consumption by way of *adaptations* and *accommodations*. We have differentiated between these two mechanisms according to the following considerations: When the modifications permit the individual to use the available dietary energy more effectively without suffering undesirable changes (for example, reducing the rate of basal metabolism or doing mechanical work with more efficient movements), we consider this to be *adaptation*. However, when these modifications permit individuals to survive but at the expense of changes that expose them to greater risks of disease and poor nutrition (for example, reducing their body reserves or rate of growth) or a decrease in the quality of their life (for example, limiting their physical capacity or reducing socially desirable activities), we classify this as *accommodation* or *adjustment* to the prevailing conditions.

Faced with a reduction of food energy, individuals first *adapt* by changing their pattern of physical activity and their energy use. When the reduction is of greater magnitude, they must *accommodate* by changes in weight and body composition and in activities of social importance. In children, the rate of growth is altered as well. When the changes persist for a sufficiently long time, they can have grave consequences for health and behaviour.

Energy consumption and energy use

The measurement of the energy consumption of a population should not be used as an indicator of its energy needs since different proportions of individuals consuming insufficient, sufficient, or excess dietary energy coexist in every country. Furthermore, it should be recognized that individuals and populations can accommodate themselves to dietary deficiencies by a decrease in their physical activity and, in case of children, by a reduction in their growth rate. However, both accommodations have important biological, economic, and social costs and do not represent desirable changes.

A chronic lack of sufficient dietary energy can also result in changes in the nature of a society. For lack of sufficient food energy an important proportion of the Latin American population has restrictions on its physical activity and/or its growth. In adults this affects the capacity to improve one's economic status, interact socially, and participate in the development of one's community. In some populations that are displaced or are at a low socio-economic level, the situation is growing even worse. In children there are important consequences for their physical and mental development.

On the other hand, an excess of food energy that results in excess weight produces adverse metabolic changes that can affect health, with a greater incidence of hypertension, diabetes, arteriosclerosis, and heart disease.

The nutritional goals should be directed at preventing all of these physiologically and socially undesirable consequences. Moreover, they are important for a realistic calculation of national requirements for food energy, based on the needs of different social and geographical sectors of the population and not on the needs of the most active or the most sedentary groups. An estimate based on the needs of the most active groups would result in an excessive figure for the agricultural and political planning of imports and would lead to recommendations that could produce obesity in many individuals. On the other hand, an estimate based on the needs of the most sedentary groups would result in insufficient production or importation of food and would cause many individuals to be malnourished.

There exists a limit in the recommendation to reduce food energy to avoid obesity. A certain level of occupational or discretional exercise is necessary to develop and maintain the physical capacity of the individual and to reduce the risk of cardiovascular diseases. Therefore, it is better to increase physical activity than to reduce the minimum energy supply of the diet.

A child should consume the amount of food necessary to attain his/her genetic potential for growth. The body size he or she reaches in adult life is not of primary importance, but the retardation in growth due to nutritional and environmental circumstances is associated with higher rates of morbidity and mortality, learning deficiencies, and a more limited physical capacity in adult life.

Cyclical changes

In some populations a loss of body weight can be observed during certain periods or seasons of the year. This weight loss demands additional consumption in a subsequent season or period of time, and influences the quantity of food consumed in a country during different times of the year. Similarly, during periods of acute infections energy intake is reduced, and during the period of recuperation additional dietary energy is needed for accelerated compensatory recovery and growth.

Digestibility of the diet

The digestibility of dietary energy sources diminishes in diets with a high fibre content. In accordance with the recommendations of the FAO/WHO/UNU consultation [2], it is suggested that the energy requirements be multiplied by 1.05 to calculate the energy that diets high in fibre supply in rural populations, and by 1.025 to calculate the energy supplied by urban diets with a moderate amount of fibre.

Energy density and food volume

The energy density of the diet is a conditioning factor important in the total dietary energy intake. If the concetration of energy is low, a young child will not be able to eat enough food to satisfy his/her energy needs. Because of this it is recommended that liquid foods for infants and preschool children should be prepared with an energy density of 0.4 kcal per millilitre. Solid foods for these children should have an energy density on the order of 2 kcal per gram. For older children and adults, an energy density on the order of 1.4–2.5 kcal per gram—combining the densities of liquid and solid foods—will permit the diet to meet the energy needs, without being so high as to cause obesity.

Practical application

The workshop discussion referred to the minimum criterion of 1.27 × BMR (basal metabolic rate) suggested by the FAO as a minimum energy supply. This only permits survival without physical activity beyond eating and attending to personal functions and is not compatible with long-term health. The group estimated that for adults an energy consumption of 1.4 × BMR represents the appropriate minimum for even sedentary survival.

For individuals who engage in discretional activities, socially desirable and necessary for promoting health, and in occupational activities that require light, moderate, or intense physical strength, these values increase to 1.55, 1.80, and 2.1 × BMR respectively. The average food energy requirements for individuals according to sex and age group are summarized in table 1. For those older than 14 years, the requirements depend on the intensity of habitual activity. For children less than 14 years old, a moderate level of activity that is considered the desirable minimum for physiological and social development is assumed.

TABLE 1. Calculated energy requirements for Latin America

Age (years) and sex	Weight (kg)	Activity level	Requirement		
			Multiple of BMR	kcal/kg/day	kcal/day
0.3–3	—[a]			100	—[a]
3.1–5	16.5			95	1,550
5.1–7	20.5			88	1,800
7.1–10					
male	27			78	2,100
female	27			54	1,800
10.1–12					
male	34		1.75	64	2,200
female	36		1.64	54	2,180
12.1–14					
male	42		1.68	55	2,350
female	43		1.59	46	2,000
14.1–18					
male	45–55	light	1.62	54–45	2,450
		moderate	1.80	58–52	2,750
		high	2.10	67–61	3,200
female	40–50	light	1.55	48–42	2,000
		moderate	1.65	51–45	2,100
		high	1.80	56–49	2,350
18.1–65					
male	60–75	light	1.55	41–37	2,600
		moderate	1.80	48–43	3,050
		high	2.10	55–50	3,500
female	45–60	light	1.55	41–35	1,950
		moderate	1.65	44–37	2,100
		high	1.80	48–41	2,300
Over 65					
male	65	light	1.40	29	1,900
		moderate	1.60	34	2,200
		high	1.90	40	2,600
female	55	light	1.40	30	1,650
		moderate	1.60	34	1,850
		high	1.80	38	2,100

Calculated on basis of ref. 2.

a. Depends on age.

Proteins

In order to satisfy the needs of all the individuals in a population, the diet should provide a quantity of protein above the average individual requirement as a safety margin. The proposal of the FAO/WHO/UNU consultation [2] to add 25% of the average requirement of individuals of determined sex and age is considered adequate. In addition, adjustments related to the digestibility of the diet's protein must be made.

It is advisable to take into account populations that live under poor hygienic conditions and have changes of intestinal mucus that diminish the digestibility of proteins. To do so would justify an increase on the order of 10% in the recommended proteins for these populations.

During an episode of diarrhoea or other acute infectious disease, a net loss of protein occurs. The loss of appetite associated with infectious disease aggravates the situation further. It is therefore necessary to increase protein intake during the period of convalescence, when appetite has recovered. Furthermore, rapid catch-up growth can be observed in children during this period, which also requires more protein. It is suggested, therefore, that estimated protein needs can be as much as 40% higher in preschool children and 20% higher in school-age children. These considerations can have special relevance when infectious diseases are endemic in populations.

Essential amino acids

The content of essential amino acids in diet should be consistent with the patterns suggested by the FAO/WHO/UNU consultation (table 2), in accordance with the amino acid requirements of preschool children. Recent studies support the use of this pattern for all age groups.

Foods of animal origin, such as meat, eggs, fish, and milk, help to provide a desirable content of protein and essential amino acids in the diet because they have a high concentration of easily digested proteins

TABLE 2. Reference amino acid patterns—suitable for all age groups except infants (milligrams per gram of protein)

Phenylalanine/tyrosine	63
Histidine	19
Isoleucine	28
Lysine	58
Methionine/cystine	25
Threonine	34
Tryptophan	11
Valine	35

Source Ref 2

and an excellent pattern of amino acids. However, these foods are not indispensable, and, when their availability is limited, two or more sources of vegetable proteins with complementary amino acid patterns can be used, with or without some animal protein. One of the sources, at least, should have a relatively high concentration of protein. A classic example of this system is the use of grain and legumes in proportions that reciprocally complement the limiting amino acids of each component. The system can be improved significantly by the use of genetically improved grains (e.g. corn high in lysine), grains cultivated with agronomic techniques that increase their protein concentration (e.g. rice), or small proportions of animal protein. The consumption of 10%–20% of proteins of animal origin, in addition to supplying essential amino acids, increases the supply and bioavailability of essential minerals in the diet.

Recommended protein quantity

On the basis of the former considerations, the daily recommended intake of protein would be 1 g per kilogram of body weight per day for an adult male who consumes one of the mixed diets common in Latin America with proteins with a "true" digestibility of 80%–85% and with a quality of 90% in relation to the pattern of reference for essential amino acids. Table 3 shows the values of reference protein (milk, egg) and of the protein of a mixed diet suggested above.

Maximum quantity of proteins and protein–energy relationships

From a practical point of view it is not necessary to fix a maximum limit for protein consumption, given the quantity that usual diets supply. However, it is recommended that proteins of animal origin should be limited to 30%–50% of the total proteins consumed, except for children under one year old. The reason for limiting the consumption of meats and other sources of animal protein is their saturated fatty acid content, as discussed in the section on fats below.

TABLE 3. Daily protein allowance (grams per kilogram of body weight, except as otherwise indicated).

	Source	
Age[a]	Milk or eggs	Mixed diet
4–6 months	1.85	2.5
7–9 months	1.65	2.2
10–12 months	1.50	2.0
1.1–2	1.20	1.6
2.1–3	1.15	1.55
3.1–5	1.10	1.5
5.1–12	1.00	1.35
Males		
12.1–14	1.00	1.35
14.1–16	0.95	1.3
16.1–18	0.90	1.2
over 18	0.75	1.0
Females		
12.1–14	0.95	1.3
14.1–16	0.90	1.2
16.1–18	0.80	1.2
over 18	0.75	1.0
Pregnancy[b]	6	8
Lactation[b]		
first 6 months	17	23
after 6 months	12	16

Source Ref 2

a In years, except as otherwise indicated

b Extra allowance, in grams per day

The concentration of proteins in relation to the total volume or mass of the diet should be taken into account, since a low concentration can prevent the fulfilling of protein needs, particularly in young children and the elderly.

As to the percentage of energy derived from proteins in relation to the total energy in the diet (PE%), healthy children and adults who eat enough to satisfy their energy needs can meet their protein needs if the diet provides between 8% and 10% of the energy in the form of good quality protein. For populations with limited animal protein in their diets and who do not live in a hygienic environment, between 10% and 12% is more appropriate, a figure very consistent for diverse populations of the world. By consuming a diet that satisfies the total food energy needs, that proportion of protein energy permits the recommendations of table 3 to be reached, even taking into account the 20%–40% additional protein suggested for children with a high incidence of infection. For the elderly whose energy consumption is reduced because of inactivity or weakness, it is recommended that the proportion of energy derived from proteins be increased to 12%–14%.

Use of local foods

Taking into account the previous considerations and the characteristics of common foods that are available in the majority of low-income homes in Latin America, it is feasible to establish dietary guidelines for diets with good quality protein without having to imitate the diets of countries or population groups with higher socio-economic status.

Carbohydrates

Generally carbohydrates are not considered in nutritional recommendations since only 50 g daily is sufficient to avoid ketosis. However, carbohydrates contribute more than half of the energy in the diets of almost all the world's populations. Given the recommendations for proteins and fats, carbohydrates should provide between 60% and 70% of the total energy of the diet.

Conditions such as obesity, diabetes, and some cardiovascular diseases are related to excessive energy consumption, which in Latin American diets frequently comes from an excess of carbohydrates.

The ingestion of certain carbohydrates such as sucrose and lactose merits special consideration.

Sucrose

Sucrose is the sugar most common in diets. It is hydrolysed by enzyme action in the intestinal tract to glucose and fructose, which are easily absorbed. Sucrose represents a concentrated source of energy that is agreeable in taste and relatively inexpensive in Latin America. Because of this it can contribute to increasing the diet's energy density. However, it must be taken into account that it supplies "empty calories" in the sense that it contains no other nutrients.

Some advocate limiting the use of sucrose because of its association with a greater incidence of dental caries, due to the proliferation of bacteria in the mouth that use sucrose as a substrate. This effect can be reduced by reducing the consumption of sucrose during and in between meals, and by using good toothbrushing techniques. Other preventive measures such as fluoridation of water or the topical application of fluoride also contribute to reducing the incidence of caries.

It is advisable to limit its use except when it is required for the diet to reach necessary energy density.

Lactose

Lasctose is the sugar in milk. It is hydrolysed in the intestinal tract by the enzyme action of lactase, giving rise to glucose and galactose. It is the principal carbohydrate in the diet of the nursing child. Milk provides, furthermore, proteins of high biological value, calcium, and other nutrients.

In Latin America, as in other regions, the majority of people have a gradual reduction of lactase from preschool age. In consequence, the consumption of lactose in quantities that exceed the capacity of the small intestine to hydrolyse it results in its reaching the colon undigested. Then fermentation by the bacterial flora produces gas and sometimes causes symptoms of flatulence, diarrhoea, and/or pain. However, there are relatively few people who do not tolerate the ingestion of moderate quantities of milk or milk products. The effects of pharmacological doses of lactose that are used in some tolerance tests are not a reliable indicator of the acceptability of milk consumed in customary quantities that generally provide between 10 g and 15 g of lactose. Programmes to distribute milk to children should not be discarded, nor should the use of milk in dietary management be restricted on the basis of its lactose content. The use of commercial milks with a reduced quantity of lactose, although convenient for the treatment of some clinical symptoms, is not justified for the general population and its cost is high.

Digestible complex carbohydrates

These are principally starches and dextrines, which constitute the main source of energy in the majority of Latin American diets. In contrast to sucrose, complex carbohydrates are not ingested in pure form but as part of a food. Cereals, roots and tubers, and some fruits provide the majority of food starches and are also important sources of other nutrients. Because of this it is preferable to eat complex carbohydrates instead of refined sugars. However, the majority of foods rich in starches become voluminous upon cooking. This limits the quantity that one can ingest, particularly for children, and must be taken into account.

Fibre

Food fibre—derived from the cell walls and intercellular structures of plants—is made up of complex polysaccharides, phenylpropanes, and other organic components that are not digested in the human small intestine, and so it arrives undigested at the large intestine.

Composition

For many years food fibre was measured as "crude fibre" on the basis of its insolubility in strong acids and alkalis. This analytic method determines cellulose and lignin, corresponding appoximately to what is today defined as the insoluble part of food fibre. It was assumed that crude fibre was metabolically homogeneous and inert. Today it is known that the various components of food fibre, such as cellulose, hemicelluloses, pectins, mucilages, gums, and lignin, differ in their physical-chemical characteristics and functions in regard to the intestine. The composition of fibre varies in different species of vegetables and is modified by the age of the plant. In addition, the preparation and cooking of many foods influences the quantity of food fibre that is not digestible. Therefore, the values for crude fibre in the food composition tables used in Latin America are obsolete.

An international group of experts is compiling information for LATINFOODS to update the tables of food composition to include the different components of fibre. This will also affect the estimate of metabolizable food energy, since digestible carbohydrates are usually calculated by difference after analysing the content of proteins, fats, crude fibre, moisture, and ash. Furthermore, the contribution of metabolizable energy derived from volatile fatty acids that are produced in the colon by bacterial decomposition of some fibres will have to be considered.

Functions

A certain amount of fibre is essential for normal gastrointestinal functioning and for the prevention of afflictions such as constipation and diverticulitis of the colon. An association has been noted between the ingestion of food fibre and the prevention or improvement of diseases such as diabetes, colon cancer, and arteriosclerosis, although the data are not conclusive.

The physiological effects of fibre are variable but depend on the proportions of its components and their physical characteristics. Some polysaccharides are fermented by bacteria to short-chain volatile fatty acids that produce flatulence and an acid medium in the large intestine. The components of polar groups affect the absorption of nutrients, faecal weight, and velocity of transit in the stomach and intestine. Lignin, pectin, and some acid polysaccharides affect the excretion of biliary acids and reduce the absorption of cholesterol, while other acid polysaccharides increase the excretion of minerals.

There is some evidence that the elderly metabolize greater quantities of fibre than young people. It is assumed that this is related to slower intestinal transit and alterations in the intestinal bacterial flora.

Dietary fibre can interfere with the absorption of energy and some nutrients. For this reason, it is recommended that the consumption of dietary fibre not be increased in populations with a high consumption of foods of vegetable origin. However, for populations with a high consumption of animal products and few vegetables, it is advisable to increase the intake of foods rich in fibre. In the absence of more precise information, it is believed that the diet of young adults should provide at least 20 g daily of fibre, measured by an analytical method that determines both water-soluble and insoluble dietary fibre. This would correspond to a minimum of 8 g or 10 g per 1,000 kcal.

Fats

Certain fats are essential in the diet because they provide fatty acids that cannot be synthesized in the human organism. The essential fatty acids form part of the phospholipids of cellular membranes and are precursors of substances that have regulatory functions, such as prostaglandins, protacyclines, thromboxins, and others.

Food sources

The principal sources of fats are the so-called "visible fats" of the diet, among which are butter, margarine, oils, mayonnaise, cream, and lard. Other important sources of fat are various foods of animal origin, such as meats, whole milk, and many cheeses, and also nuts and oleaginous seeds.

Fish are a source of fats of potential benefit, since their fats are rich in essential fatty acids, especially those in the n-3 series. Many marine and freshwater fish in Latin America have important concentrations of these fats.

Essential fatty acids

Dietary fats must supply adequate quantities of essential fatty acids in the series of linoleic acid (n-6) and alpha-linolenic acid (n-3), which cannot be derived from each other. Furthermore, the sources of these acids are different. The acids in the n-6 series are abundant in oil seeds, while those in the n-3 series are abundant in leaves and fish. It is estimated that an adult needs about 3% of total food energy in the form of essential fatty acids. It is not difficult to ingest this quantity with customary diets, even when they have a low total fat content.

The requirement for these fatty acids for nursing children is on the order of 5% of food energy, a quantity that is easily provided by maternal milk or cow's milk, except when it is skimmed. For this reason and because of its low energy density and poor content of other nutrients, the use of skim milk in the feeding of nursing or young children must be avoided, or at least foods rich in essential fatty acids and other missing nutrients should be added to or included in diet.

It is recommended that between 10% and 20% of the polyunsaturated fatty acids in the diet be of the n-3 series. The need for series n-3 acids can be satisfied by alpha-linolenic acid, which is found in a high proportion in soybean oil, or by its derivatives eicosapentonoic and decosahexanoic acids, which are found in fish and in the fat of wild animals.

Recommended fat intake

Fats are a concentrated source of energy, highly useful in increasing the energy density of diet. This is particularly important for young children who have limited gastric capacity. For this reason, and on the basis of fats providing essential fatty acids and their influence on the absorption of liposoluble nutrients, it is recommended that fats make up approximately 20% of the total energy of the diet, but not more than 25%. Some nutritional guidelines recommend a maximum limit of 30% of energy in the form of fats, but this is considered excessive on the basis of experimental results and recent epidemiological evidence regarding health disturbances associated with that high an intake of fats.

In addition, it is recommended that the fat intake comprise approximately equal parts of saturated, mono-unsaturated, and polyunsaturated fatty acids. In any case, the intake of saturated fatty acids in quantities exceeding 8% of total food energy should be avoided. On the other hand, the quantity of mono-unsaturated acids could be greater than 8% of the total energy, on the basis of recent investigations using olive oil.

Palm and coconut oils

The oil from coconuts is highly saturated and should be used in human nutrition only within the limits for saturated fat of 8% of total food energy.

In various Latin American countries the production of palm oil has grown as an attractive economic option. The crude oil of the African oil palm has 50% saturated fatty acids (principally palmitic acid), 40% oleic acid (mono-unsaturated), and only 10% linoleic acid (polyunsaturated). However, the product refined for human consumption, palm olein, has a smaller proportion of saturated acids. Recent studies on experimental animals and humans indicate that palm olein does not increase the level of serum cholesterol [8], although it does not reduce it significantly, as oils with a higher proportion of polyunsaturated fat, such as corn, sunflower, and sesame oils, have been observed to do in similar studies. It is necessary to note that there are still a great number of questions on this topic which should be investigated.

Cholesterol

Cholesterol is not a nutrient that needs to be supplied by the diet, but it was considered in the meeting because its ingestion in excess should be avoided. The foods richest in cholesterol are eggs (a yolk contains between 200 and 300 mg, according to its size), butter, sausage, cream and products containing it, seafood, and viscera. Among the latter, brains contain very high quantities, up to 2,000 mg per 100 g.

Even though cholesterol forms an important part of cellular membranes and is a precursor of various hormones, there is no dietary requirement for it, because the organism can synthesize all the cholesterol needed. On the other hand, it has been shown that people can vary the synthesis of endogenous cholesterol depending on the amount of food cholesterol. This capacity to adapt is not unlimited, and at intakes above approximately 300 mg per day, part of the population shows an undersirable increase in the concentration of plasma cholesterol. It is therefore considered prudent to recommend that cholesterol intake not exceed 100 mg per 1,000 kcal for adults.

As far as children are concerned, it should be recognized that in various Latin American populations eggs provide a significant part of the proteins of high biological value in the diet. Considering this, and in the absence of further evidence, it is suggested tentatively that for children cholesterol intake should not exceed 300 mg per day, equivalent to an average of 1 or 1.5 hen eggs a day.

Vitamins

This document considers only vitamins whose intake represents an existing or potential nutrition problem in Latin America. These are vitamin A, vitamin C, folic acid, and, to lesser extent, thiamin, riboflavin, and niacin. It is accepted that, if diets are modified so as to correct deficiencies of these vitamins, it is highly probable that they will be adequate in all other vitamins.

The concept of "nutrient density" was used, with vitamin requirements expressed as quantities of each vitamin per 1,000 kcal of the diet (table 4), because this focus facilitates the planning and formulation of diets for the family and population, especially in the case of micronutrients. This implies that if the diet is ingested in quantities sufficient to satisfy energy needs, vitamin needs will also be fulfilled. This approach results in intakes that may be higher than those recommended for some groups as a function of their age, sex, and physiological state. However, it is considered that they can be attained with the usual diets in Latin America. It should be recognized, however, that if the different foods of a mixed diet are not eaten in balanced proportions, the intake of some nutrients could be insufficient even though total food energy needs are met.

This concept was applied from six months of age, since there is no convincing evidence that vitamin

TABLE 4 Daily vitamin needs

Age (years)	Weight (kg)	Energy requirement (kcal)	Vitamins (units per 1,000 kcal of dietary energy)					
			Vit A (μg)	Vit C (mg)	Folate (μg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)
0.5–1	9	900	270	20	70	0 4	0.5	6
1 1–3	12	1,200	375	25	95	0 5	0.8	9
3.1–5	16.5	1,550	485	30	115	0 6	0.9	11
5 1–7	20.5	1,800	540	35	135	0.7	1 1	13
7 1–10	27	1,950	585	40	145	0 8	1 2	14
10.1–12	35	2,100	630	40	160	0.8	1 3	15
Male								
12 1–14	42	2,350	705	45	175	0 9	1 4	16
14.1–18	50	2,750	825	55	205	1 1	1.6	19
18.1–65	68	3,050	915	60	230	1 1	1 8	21
over 65	65	2,200	660	45	165	0 9	1 3	15
Females								
12 1–14	43	2,000	600	40	150	0 8	1 2	14
14 1–18	45	2,150	645	45	160	0 9	1 3	15
18.1–65	53	2,100	630	40	160	0 8	1 3	15
over 65	55	1,850	555	35	140	0 7	1 1	13
Pregnancy[a]		285	100	10	250	0 1	0 2	2
Lactation[a]		500	400	10	150	0.2	0.4	4

Sources. Refs 2 and 3

a Supplementary amounts

needs in relation to dietary energy are different in the different age and sex groups, with the exception of folates for pregnant women. The vitamin requirements of the nursing child up to six months of age are satisfied with the breast milk of a healthy and well-nourished mother. In the case of malnourished lactating mothers, it is recommended that the deficiencies in the mother be corrected in order to improve the composition of the milk. For children who are not breast-fed, the recommendations for vitamins that breast milk substitutes should supply would be those indicated for infants older than six months.

Vitamin A

Hypovitaminosis A is prevalent in certain sectors of the Latin American population. In these sectors, in addition to insufficient dietary content, there exist factors that reduce the bioavailability of vitamin A and carotenes, such as intestinal parasitism, diarrhoea, and diets very low in fat.

The concentration of vitamin A suggested for the family diet is 300 retinol equivalents (RE) for each 1,000 kcal.

Vitamin A in the diet provides retinol (preformed vitamin A) and various carotenes that are pro-vitamin A. Retinol is found only in foods of animal origin, especially liver, whole milk, and eggs. Certain dark yellow vegetables, dark green leaves, and yellow fruits, such as papaya and mango, and some varieties of yellow corn are good sources of carotene.

By virtue of the fact that the biological utilization of retinol is superior to that of carotenes, it is advantageous for part of the activity of vitamin A to be provided by this source. Moreover, information about the vitamin value of different carotenes is scarce and may be overestimated.

Ascorbic acid

Ascorbic acid, in addition to functioning in intermediate metabolism, encourages the absorption of iron, especially that of vegetable origin, which predominates in many Latin American diets. As a consequence, as is discussed in the section "Minerals" below, vitamin C should be ingested along with foods that contain iron.

The proposed level for ascorbic acid in the family diet is based on a concentration of the nutrient of 20 mg per 1,000 kcal. When this is computed in terms of daily dietary supply for a man with an energy need of 3,000 kcal per day, it results in a recommendation of 60 mg of vitamin C per day. This recommendation is based on a reanalysis of available biochemical and physiological information, which indicates that with a dietary supply of 60 mg per day, a stabilization or "plateau" is reached in the concentration of ascorbic acid in the leucocytes, and that the renal threshold for the excretion of ascorbic acid is surpassed with higher ingestions.

Because ascorbic acid is destroyed by heat in the presence of oxygen, one can overestimate the quantity of the vitamin provided by foods that are eaten in a cooked form For this reason fruits that are eaten raw and fresh are the most dependable sources of ascorbic acid A wide variety of cultivated and wild fruits are good sources of vitamin C, particularly citrus fruits, papaya, haw, mango, and guava. Some vegetables such as broccoli, spinach, and other green leaves also supply appreciable quantities. Among roots and tubers, potatoes and yucca are particularly important sources of this vitamin in populations in which they are consumed in abundance However, the vitamin is destroyed by dehydration.

Folates

It is proposed that the family diet should provide folates in a concentration of 75 μg per 1,000 kcal. This level is sufficient for all ages and sexes, with the frequent exception of pregnant lactating women. An FAO/WHO committee of experts in 1985 recommended, as a safety measure, a daily intake of 350 μg during pregnancy and 270 μg during lactation. Customary diets in Latin America often do not provide this quantity of folates, and unless they can be improved, it is necessary to supplement them with additional quantities of this vitamin, especially in pregnancy.

A good many foods of animal and vegetable origin contain folates. The best sources of the vitamin include meats, particularly liver, whole grains, leafy vegetables, and most fruits. These folates are sensitive to heat. Therefore, diets containing only cooked foods are potentially poor in this vitamin. This should be taken into account when cow's milk is subjected to strong boiling for hygienic reasons. For the same reason, powdered milks contain minimal quantities of this vitamin.

Thiamine, riboflavin, and niacin

The calculation of the daily supply of thiamin, riboflavin, and niacin on the basis of their concentration per 1,000 kcal has been accepted practice for many years. The figures suggested here are at least 0.4 mg of thiamine, 0.6 mg of riboflavin, and 7 mg of niacin per 1,000 kcal. These levels are satisfactory in covering the needs of any age and physiological state.

Among foods especially rich in thiamine are whole or enriched grains, nuts, and legumes. Vegetables, roots, tubers, and fruits supply moderate quantities, as do pork and some organ meats. It is necessary to emphasize the susceptibility of thiamine to degradation by heat in an alkaline medium. For this reason the practice of adding bicarbonate to water during cooking is undesirable.

The best sources of riboflavin are milk and its derivatives, eggs, liver, and leafy vegetables. Although grains are not particularly rich in the vitamin, they constitute an important source in many diets because of their high consumption. This is even greater when the grains are not highly refined.

The tryptophan of proteins can be metabolically transformed to niacin by the human organism. It is estimated that approximately 60 mg of tryptophan give rise to 1 mg of niacin. For this reason, a food may be a good source of niacin or niacin equivalents if it contains appreciable quantities of preformed niacin, tryptophan, or both. When tryptophan is the limiting amino acid in the diet, it is recommended that the dietary supply of niacin be calculated only on the basis of preformed vitamin Peanuts, legumes, meats, fish, eggs, and milk products are good sources of niacin equivalents because of their high content of tryptophan. Grains supply important quantities of niacin because of the large quantities in which they are ordinarily consumed. In corn, niacin is chemically linked in a form composite that is absorbed poorly by the human intestine. The treatment of corn with an alkali and heat, as is common in Mexico and Central America in the preparation of tortillas, frees the vitamin and makes tryptophan more available. The cleaning and refining of grain reduces its niacin content significantly.

Vitamin supply in situations of low energy intake

When the energy intake of adults and adolescents falls below 2,000 kcal per day, their vitamin needs do not decrease proportionally. Therefore, a minimum intake of vitamins must be maintained corresponding to that recommended for 2,000 kcal per day. This situation presents itself most frequently in persons of advanced age and in those who are excessively sedentary or are undertaking weight-loss diets.

Vitamin supplements

There is no evidence that any benefit can be derived from the consumption of vitamin supplements above the suggested daily dietary supplies. It is to be noted, furthermore, that excessive ingestion of vitamins A and D and, in certain cases, of niacin can result in toxicity. Similarly, the repeated consumption of high doses of ascorbic acid does not have health benefits. It gives rise to high urinary concentrations of oxalates, which can produce renal calculi. Consequently, supplements and "megadoses" of vitamins should not be used indiscriminately, but rather be reserved exclusively for well-defined clinical situations and be taken under medical supervision. In addition, the unnecessary use of vitamin supplements or megadoses represents a waste of economic resources. In poor families, this reduces the capacity to acquire foods beneficial to the health of the whole family.

Fortification and enrichment of foods

Where hypovitaminosis is highly prevalent in particular countries or population groups, it is necessary to consider the convenience or necessity of enriching or fortifying some food vehicles with vitamin A and vitamin D. However, these actions should be temporary in order to resolve the existing problem. When dietary, socio-economic, and ecological conditions permit, these measures should be supplanted by the rational use of foods and diets.

Minerals

As in the case of vitamins, this document considers only those minerals whose dietary intakes represent a real or potential nutrition problem in Latin America. These are iron, zinc, iodine, fluorine, sodium, and calcium. There are other trace elements known to be biologically needed, such as potassium, copper, selenium, magnesium, molybdenum, manganese, cobalt, and chromium. However, there have been no reported public health problems related to the deficiency or excess intake of any of these in Latin America, and there are no studies about their supply in the usual Latin American diets.

For most of the minerals the recommendations for daily intake are calculated per 1,000 kcal of the diet. The justifications for this are given in the introduction to the section on vitamins. Because the recommendations for iodine are very small and less dependent on the individual's age and energy intake, they are expressed as a total intake per day. In the case of sodium, the only quantitative recommendation made is the maximum limit of daily intake, independent of the total energy intake.

Iron

Iron forms a part of molecules such as haemoglobin and myoglobin, and acts as a coenzyme in many reactions in the organism, especially in oxidation-reduction reactions. The majority of the body's iron is in the circulating haemoglobin and reserves in certain organs.

Needs

Iron needs vary with the individual's age, sex, physiological condition, and body reserves of iron. It is also necessary to consider the bioavailability of the iron in the diet and its intestinal absorption, which varies with the individual's iron nutritional status.

A newborn infant has considerable iron in its circulating erythrocytes, and during the first months of life the iron in reserve grows at the expense of circulating haemoglobin. During the first four to six months of life, nursing children fulfil their iron requirements from their body reserves and breast milk; although the concentration of iron in the latter is low, it is absorbed to a high degree. The reserves disappear between four and six months of age, and the diet must then begin to supply sufficient quantities of the mineral in order to prevent anaemia.

Because of their growth, children need a diet proportionally higher in iron than adults; this need is accentuated during puberty. With menarche, women begin to lose blood periodically. During each menstrual period, an average of 25–30 ml of blood are lost, equivalent to 10–15 mg of iron, but some women lose more than 80 ml. This produces an increase in the quantity of iron that the diet must supply.

The need for iron increases by a total of approximately 800 mg during the entire course of pregnancy. In well-nourished women with good body reserves of iron who continue diets that have highly bioavailable iron, this increased need can be satisfactorily met. However, when women begin their pregnancy with little or no iron reserves because of a chronic deficiency of this mineral and continue eating a diet with low iron bioavailability, as occurs in great sectors of the Latin American population, it is not possible to satisfy the iron requirements with only foods in their natural form. Therefore, it is necessary to use foods fortified with iron or to administer pharmacological iron preparations in order to provide 30–60 mg of iron per day.

The decrease in iron because of blood loss during and after childbirth is compensated for in great part by the decrease in the volume of circulating erythrocytes. During lactation, menstruation is suspended and the loss of iron is reduced, but 0.3–0.5 mg of iron per day is excreted with the milk. Because of this, there is an increase in the physiological need for iron during lactation, and the diet should provide about 2–4 mg more iron per day than for the non-lactating woman who is not menstruating or who is post-menopausal.

Food sources

The quantity of iron in foods does not necessarily correspond to the amount absorbed by the human intestine nor to its bioavailability to the organism. For example, while haem iron is 20% to 30% absorbed, the non-haem iron in the majority of grains and legumes is less than 5% absorbed, and while the iron in human milk is 40% to 50% absorbed, that in cow's milk is 10% to 15% absorbed.

In addition, regulating mechanisms exist that cause iron absorption to vary according to the concentration of haemoglobin and body reserves of iron. Therefore, anaemic persons absorb greater proportions than normal persons, and the degree of absorption grows according to the severity of the anaemia.

These factors should be taken into account in interpreting the quality of food sources of iron, instead of considering only the chemical content of iron in the food. This content is relatively great and its bioavailability high in liver and beef; it is found in smaller quantity but also in highly bioavailable form in chicken and seafood. The iron content in grains, legumes, and leafy vegetables is quite variable and its bioavailability is less than that of iron of animal origin.

Iron that contaminates food, derived from dust in the environment, from cooking utensils, or from industrial processing, can represent a relatively high proportion of ingested iron. Unfortunately, there is no appropriate method available to determine how this iron interacts with the iron in foods, what its bioavailability is, and how much it contributes to satisfying the needs of the individual.

Absorption of iron in a mixed diet

The absorption and bioavailability of iron in a mixed diet whose ingredients are consumed in different proportions and in a non-uniform manner at each meal is not known. Besides the differences between haem and non-haem iron, the latter is strongly influenced by various components in the diet. In this way, the absorption of non-haem iron improves in the presence of meat, chicken, fish, seafood, and various organic acids, especially ascorbic acid. In addition, diverse substances such as tannins and other polyphenols, phytates, certain proteins (such as egg yolk), and some food fibres reduce its absorption. Depending on the presence of such enhancing or inhibiting substances, the absorption of iron in a meal can vary from 1% to 30% in persons with a good nutritional state of iron.

An FAO/WHO committee of experts, convened in 1985, whose report has not yet been published, suggested dividing the common diets in different parts of the world into three categories: those with "low," "intermediate," and "high" bioavailability of iron, in which—in persons without adequate reserves of iron but with a normal capacity to absorb and transport it—the average absorption of the mixture of haeminic and non-haeminic iron is about 5%, 10%, and 15% respectively. These diets can be characterized as follows:

Simple and uniform diets based on grains, roots, and tubers with insignificant amounts of meat, fish, or sources of ascorbic acid have a low bioavailability of iron. In these diets foods such as corn, beans, whole wheat, and sorghum predominate and have substances that inhibit the absorption of iron. They are common in the poorest socio-economic classes in almost all of Latin America.

Diets with intermediate bioavailability of iron are those that are based principally on grains, roots, and tubers but include some foods of animal origin and sources of ascorbic acid. A diet of low bioavailability can become "intermediate" by augmenting the content of foods that favour the absorption of iron. Similarly, absorption is reduced when diets with high bioavailability are consumed along with inhibitors of iron absorption, such as tea and coffee. This is common in the middle socio-economic class in many countries in the region.

Diets with a high bioavailability of iron are varied and include large and frequent quantities of meat, chicken, fish, or meals rich in ascorbic acid. They are common in countries with high meat consumption and in the upper socio-economic groups of Latin America.

Table 5 shows the quantities of iron that should be supplied by these three categories of diets to prevent anaemia in 95% of the population. This varies depending on whether body reserves of iron are adequate or low. In the latter case, the expected absorption of iron would be about 22.5%, 15%, and 7.4% when its bioavailability is high, intermediate, or low respectively. The increase of absorption will permit the gradual improvement of iron reserves.

The FAO/WHO committee also defined "basal requirements" that correspond to an adequate supply of iron in the tissues and the maintenance of all functions

TABLE 5. Daily iron intake required to prevent anaemia in almost all of the population (mg per 1,000 kcal of dietary energy)

Age (years)	Bioavailability of iron in the diet		
	High	Intermediate	Low
0.5–1	5	7	14
1.1–2	3	4	8
2.1–6	3	5	9
6.1–12	5	8	16
Males			
12.1–16	8	12	24
over 16	5	8	15
Females			
12.1–16	9	13	27[a]
menstruating	10	14	29[a]
lactating	6	9	17
post-menopausal	4	6	13

Source Ref 9

a Very difficult to achieve with usual diet