Technical and Research Department

Module 1
The Basics of Nutrition

Action contre la Faim – France

Version 1
2007

The Following document is an actualisation of:
Module 1 Basics of Nutrition and General food Distributions / March 2000

SUMMARY

TEACHING OBJECTIVES

After studying this module, you should be able to:

1- Define the individual needs and necessary nutritional requirements for different ages

2- Know the nutritional values of the principle foods and assess, to which degree, they can cover the nutritional requirements of individuals

3- Calculate a balanced food ration (both in quality and in quantity)

4- Know the procedures to follow to enrich a food ration

5- Define type 1and type 2 micronutrients

6- Define the different types of malnutrition

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SOME DEFINITIONS.

Food.
«Food can be considered as all that is a source of nourishment, that is to say, nutritional materials that can be directly absorbed, but should not only be named by custom, desires and types of civilisation»
Definition of the New and Popular Encyclopaedia – S.MAUNDER (1848).

«Foodstuffs comprising nutrients, therefore nourishment, able to satisfy the appetite, so appetising and habitually consumed in a considered society and can therefore be considered customary». (TREMOLIERE.S)

Feeding.
«The action of providing and consuming food» (Larousse).

Nutrients.
All the elements or components either organically or inorganically composed contained in foods and that can be utilised by the organism without suffering digestive transformation so that they may be assimilated by the cells. The foods are transformed into nutrients by the digestive juices. The proteins are the 'forming' or 'building' nutrients and the sugars and fats are the energetic nutrients».
(Flammarion Medical Dictionary).

Nutrition.
1. The collection of processes whereby living organisms utilise food to ensure the life, their growth, the normal functioning of organs and their tissues as well as the production of energy. The idea of 'nutrition' is understood as 'feeding', but the two terms are not synonymous.

2. Science devoted to the study of food and their nutritional value, the reactions to the ingestion of nourishment as well as the variations in feeding whether the subject is ill or healthy. This pluri-disciplined science is interested in the physiological and physio-pathological aspects, in the technology and the economy of foodstuffs, in the psychosocial, sociological, historical and geographical behaviour of food.

(Flammarion Medical Dictionary).

Nutritional Status.
Status of the organism is the result of digestion, absorption and utilisation of food, as well as factors of natural pathology. (Defined by World Health Organisation).

Nutritional Needs.
The nutritional needs are studied by physiologists and biologists. They are able to estimate to a certain precision if, at the same time, criteria are set that are to be used for the evaluation of the needs. (For example, the minimal necessary quantity of a given nutrient to compensate for all the losses of the organism, to assure the metabolic functions where the nutrients are involved, as well as maintaining the reserves). The condition in which the subject is confronted also has to be defined. These would include the environment, previous nutritional status, composition of the ration, etc.

Recommended Intakes.
The nutritional intakes are the chosen values by a group of experts which took into account not only the scientific data concerning nutritional requirements, but also the nutrient absorption rate;

the bioavailability; and the motivation and food practices of the people concerned and the extent to which these habits are harmful to health. These recommended intakes can be defined as the average quantities of each nutrients per person per day in order to satisfy the needs of a group of individuals or a population to a level that ensures a good state of nutrition.

These intakes should be sufficiently large to satisfy the needs of almost all the individuals in a group with specific characteristics (age, sex, height, activity and physique). (HERCEBERG S., DUPIN H, PAPOZ L, GALAN P. – Nutrition and Public Health: Epidemiological and Political Approach to –Prevention – Paris: Lavoisier, 1985).

I- NUTRITIONAL STATUS

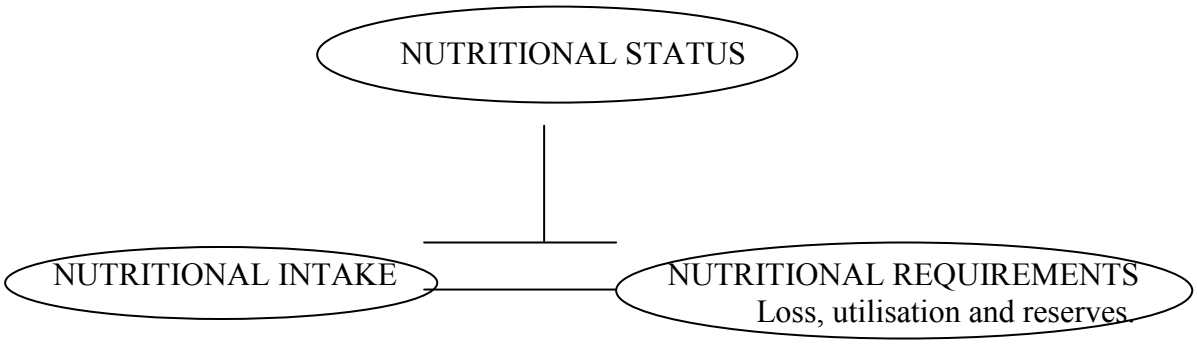
A- SIGNIFICANCE OF NEEDS AND RECOMMENDED INTAKES

Human nutritional status is conditioned essentially by its relationship with its physical, biological and cultural environment. Only an ecological approach can be allowed today to understand the respective place of the many integrated determinants in the development of nutritional problems, such as they are observed in our diverse human societies. These determinants are of a very diverse nature: biological (physiological, metabolical), socio-economic, socio-cultural, agricultural, demographic, political….

They all have an impact on the nutritional status of individuals, either by determining their **food intake** or on their **nutritional needs** (depending on their way of life)

The nutritional status is good when food intake equals nutritional needs:

Factors affecting Nutritional Status.



Individuals differ from one to another regarding their needs or the metabolic utilisation of the nutrients, it is evident that the 'recommended nutritional intakes', calculated to satisfy the grand majority of individuals, exceed the needs of a certain number of individuals. A lower intake is not necessarily synonymous with deficiency, but the more the intake is deemed deficient in relation to the recommended intake, the more the individual risks not satisfying his or her proper level of requirements. The lower the intake, the higher the risk of developing a deficiency.

There are two different ways of calculating the recommended intake:

1- Recommending **high intakes**: recommending « comfortable » intakes that cover the needs of 97.5 % of the population will reduce the risk of deficiency. This means that the intake will exceed the needs of a great proportion of the population, and this method is used in the case of nutrients that cannot cause adverse effect when taken in excess. These nutrients are, for example, vitamins, minerals, proteins. However, a maximum intake should be defined for some of these nutrients, like for example vitamins D and A, in order to avoid certain side effects that can be linked to an intake that is too high compared to the needs.

2- Recommending intakes that correspond to the **average needs** of the population. In this case, the recommended intake covers the needs of 50% of the population. This method is used for **energy.** An excessive intake of calories can lead to overweight and obesity, which

in turn can be the cause of different diseases. It is therefore not appropriate to recommend an intake that is higher than the needs of the majority of the population. Recommended energy intake is an average but there are huge differences between individuals as regards their real energy needs.

The figures indicated by the Committee of experts, in France and in other countries, should not in any case be taken as calculated 'norms'. These are the 'markers', the indicative values that are judged as desirable, not for an isolated individual, but for a group of individuals in function of age, sex, as well as other parameters.

Source: «Food and Human Nutrition» DUPIN/CUQ

The calorific supply depends on the food in question. The foods hold their nutritional value in a relatively limited number of substances, that are the **nutrients**. To distinguish:
- Macronutrients: Proteins, fats and sugars, which contain energy and certain minerals.
- Micronutrients: mostly vitamins and minerals assist in the utilisation of proteins, fats and sugars.

Some nutrients present in food are very complex and need to be broken down (into cellular nutrients) during digestion, so that the body can make use of them. Others, like vitamins and minerals, can be absorbed straight away.

Categorisation of Principle Nutrients.		*Cellular nutrients*
Proteins----------	*Digestion---------->*	*Amino Acids*
Complex Fatty Acids----------	*Digestion---------->*	*Fatty Acid, glycerol, cholesterol*
Complex Carbohydrates----------	*Digestion---------->*	*Glucose (sugars)*
Simple Carbohydrates----------		
Minerals (in the form of salt)	*Direct Absorption---->*	*Mineral Salts*
Vitamins		*Vitamins*
Water		*Water*

B- REQUIREMENTS AND DIETARY REFERENCE VALUES

1- ENERGY

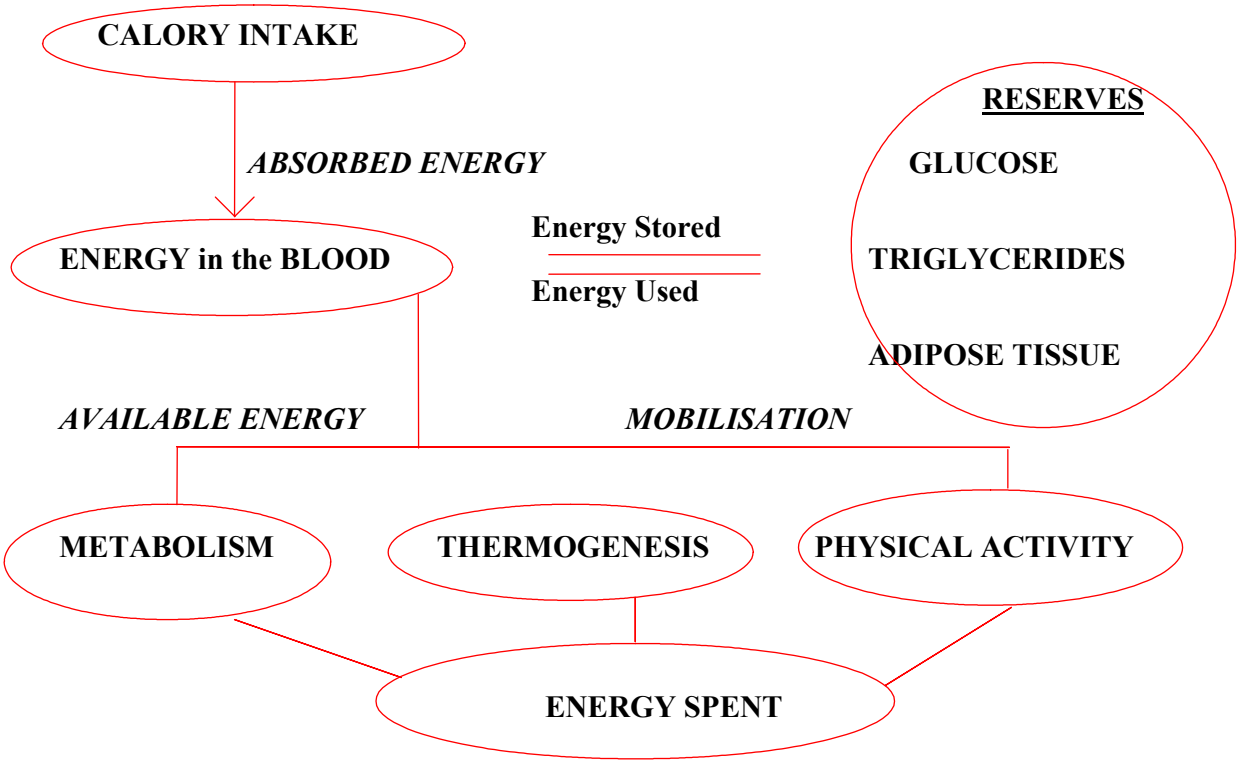
1.1- Introduction

Human energy requirements are estimated from measures of energy expenditure plus the additional energy needs for growth, pregnancy and lactation. Recommendations for dietary energy intake from food must satisfy these requirements for the attainment and maintenance of optimal health, physiological function and well-being. The latter (i.e. well-being) depends not only on health, but also on the ability to satisfy the demands imposed by society and the environment, as well as all the other energy-demanding activities that fulfil individual needs.

Energy balance is achieved when input (i.e. dietary energy intake) is equal to output (i.e. total energy expenditure), plus the energy cost of growth in childhood and pregnancy, or the energy cost to produce milk during lactation. When energy balance is maintained over a prolonged period, an individual is considered to be in a steady state. This can include short periods during which the dayto-day balance between intake and expenditure does not occur. An optimal steady state is achieved when energy intake compensates for total energy expenditure and allows for adequate growth in children, and pregnancy and lactation in women, without imposing metabolic, physiological or behavioural restrictions that limit the full expression of a person's biological, social and economic potential.

Within certain limits, humans can adapt to transient or enduring changes in energy intake through possible physiological and behavioural responses related to energy expenditure and/or changes in growth. Energy balance is maintained, and a new steady state is then achieved. However, adjustments to low or high energy intakes may sometimes entail biological and behavioural penalties, such as reduced growth velocity, loss of lean body mass, excessive accumulation of body fat, increased risk of disease, forced rest periods, and physical or social limitations in performing certain activities and tasks. Some of these adjustments are important and may even increase the chances of survival in times of food scarcity.

Principle of Balanced Energy:



1.2- Definitions:

An adequate, healthy diet must satisfy human needs for energy and all essential nutrients. Furthermore, dietary energy needs and recommendations cannot be considered in isolation of other nutrients in the diet, as the lack of one will influence the others. Thus, the following definitions are based on the assumption that requirements for energy will be fulfilled through the consumption of a diet that satisfies all nutrient needs.

Energy requirement is the amount of food energy needed to balance energy expenditure in order to maintain body size, body composition and a level of necessary and desirable physical activity consistent with long-term good health. This includes the energy needed for the optimal growth and development of children, for the deposition of tissues during pregnancy, and for the secretion of milk during lactation consistent with the good health of mother and child.

The recommended level of dietary energy intake for a population group is the mean energy requirement of the healthy, well-nourished individuals who constitute that group.

Basal metabolic rate (BMR): The minimal rate of energy expenditure compatible with life. It is measured in the supine position under standard conditions of rest, fasting, immobility, thermoneutrality and mental relaxation. Depending on its use, the rate is usually expressed per minute, per hour or per 24 hours.

Body mass index (BMI): The indicator of weight adequacy in relation to height of older children, adolescents and adults. It is calculated as weight (in kilograms) divided by height (in meters), squared.

The acceptable range for adults is 18.5 to 24.9, and for children it varies with age.

Doubly labelled water (DLW) technique: A method used to measure the average total energy expenditure of free-living individuals over several days (usually 10 to 14), based on the disappearance of a dose of water enriched with the stable isotopes 2H and 18O.

Energy requirement (ER): The amount of food energy needed to balance energy expenditure in order to maintain body size, body composition and a level of necessary and desirable physical activity, and to allow optimal growth and development of children, deposition of tissues during pregnancy, and secretion of milk during lactation, consistent with long-term good health. For healthy, well-nourished adults, it is equivalent to total energy expenditure. There are additional energy needs to support growth in children and in women during pregnancy, and for milk production during lactation.

Heart rate monitoring (HRM): A method to measure the daily energy expenditure of free-living individuals, based on the relationship of heart rate and oxygen consumption and on minute-by-minute monitoring of heart rate.

Total energy expenditure (TEE): The energy spent, on average, in a 24-hour period by an individual or a group of individuals. By definition, it reflects the average amount of energy spent in a typical day, but it is not the exact amount of energy spent each and every day.

1.3- Sources of dietary energy

Energy for the metabolic and physiological functions of humans is derived from the chemical energy bound in food and its macronutrient constituents, i.e. carbohydrates, fats, proteins and ethanol, which act as substrates or fuels. After food is ingested, its chemical energy is released and converted into thermic, mechanical and other forms of energy.

1.4- Components of energy requirements

Human beings need energy for the following:

- *Basal metabolism*. This comprises a series of functions that are essential for life, such as cell function and replacement; the synthesis, secretion and metabolism of enzymes and hormones to transport proteins and other substances and molecules; the maintenance of body temperature; uninterrupted work of cardiac and respiratory muscles; and brain function. The amount of energy used for basal metabolism in a period of time is called the *basal metabolic rate* (*BMR*), Depending on age and lifestyle, BMR represents 45 to 70 percent of daily total energy expenditure, and it is determined mainly by the individual's age, gender, body size and body composition.

- *Metabolic response to food*. Eating requires energy for the ingestion and digestion of food, and for the absorption, transport, interconversion, oxidation and deposition of nutrients. These metabolic processes increase heat production and oxygen consumption, and are known by terms such as *dietary-induced thermogenesis*, *specific dynamic action of food* and *thermic effect of feeding*. The metabolic response to food increases total energy expenditure by about 10 percent of the BMR over a 24-hour period in individuals eating a mixed diet.

 Thermogenesis: To maintain a constant body temperature (near to 37^0C). Energy expenditure for thermo-regulation is necessary in order to fight against the cold and varies according to external temperatures.
WFP / UNHCR recommend an addition of 100 kcal, for each increment of five degrees below 20^0C

 Physical activity. This is the most variable and, after BMR, the second largest component of daily energy expenditure. Humans perform *obligatory* and *discretionary* physical activities. Obligatory activities can seldom be avoided within a given setting, and they are imposed on the individual by economic, cultural or societal demands. They include daily activities such as going to school, tending to the home and family and other demands made on children and adults by their economic, social and cultural environment.
Discretionary activities, although not socially or economically essential, are important for health, well-being and a good quality of life in general. They include the regular practice of physical activity for fitness and health; the performance of optional household tasks that may contribute to family comfort and well-being; and the engagement in individually and socially desirable activities for personal enjoyment, social interaction and community development.

 Growth. The energy cost of growth has two components: 1) the energy needed to synthesize growing tissues; and 2) the energy deposited in those tissues. The energy cost of growth is about 35 percent of total energy requirement during the first three months of age, falls rapidly to about 5 percent at 12 months and about 3 percent in the second year, remains at 1 to 2 percent until mid-adolescence, and is negligible in the late teens.

 Pregnancy. During pregnancy, extra energy is needed for the growth of the foetus, placenta and various maternal tissues, such as in the uterus, breasts and fat stores, as well as for changes in maternal metabolism and the increase in maternal effort at rest and during physical activity.
The increase in needs regarding pregnancy is particularly important to note for those women having smaller reserves to support this rise. It is principally body fat that is expended at the start of a pregnancy. Pregnant women should increase their food intake by 85 kcal/day in the first trimester, 360 kcal/day in the second and by 475 kcal/day in the third.

 Lactation. The energy cost of lactation has two components: 1) the energy content of the milk secreted; and 2) the energy required to produce that milk. Well-nourished lactating women can derive part of this additional requirement from body fat stores accumulated during pregnancy.

1.5- Calculation of energy requirements

The total energy expenditure of free-living persons can be measured using the doubly labelled water technique (DLW)[1] or other methods that give comparable results. Among these, individually calibrated heart rate monitoring[2] has been successfully validated. Using these methods, measurements of total energy expenditure over a 24-hour period include the metabolic response to food and the energy cost of tissue synthesis. For adults, this is equivalent to daily energy requirements. Additional energy for deposition in growing tissues is needed to determine energy requirements in infancy, childhood, adolescence and during pregnancy, and for the production and secretion of milk during lactation. It can be estimated

[1] Cf. 1.2- Definitions
[2] Cf. 1.2- Definitions

from calculations of growth (or weight gain) velocity and the composition of weight gain, and from the average volume and composition of breast milk.
Total energy expenditure has also been measured in groups of adults, but this has been primarily in industrialized countries. Variations in body size, body composition and habitual physical activity among populations of different geographical, cultural and economic backgrounds make it difficult to apply the published results on a worldwide basis. Thus, in order to account for differences in body size and composition, energy requirements were initially calculated as multiples of BMR. They were then converted into energy units using a known BMR value for the population, or the mean BMR calculated from the population's mean body weight. To account for differences in the characteristic physical activity of the associated lifestyles, energy requirements of adults were estimated by factorial calculations that took into account the times allocated to activities demanding different levels of physical effort.
The extra needs for pregnancy and lactation were also calculated using factorial estimates for the growth of maternal and foetal tissues, the metabolic changes associated with pregnancy and the synthesis and secretion of milk during lactation.

For further information on calculation formula, Cf. "Human energy requirements" Report of a Joint FAO/WHO/UNU Expert Consultation Rome, 17-24 October 2001

Expression of requirements and recommendations
Energy requirements of the organism and energy content of foods are expressed in kilojoules

1 kcal =4.184 kJ; 1 kJ = 0.239 kcal

Gender, age and body weight are the main determinants of total energy expenditure. Thus, energy requirements are presented separately for each gender and various age groups, and are expressed both as energy units per day and energy per kilogram of body weight. As body size and composition also influence energy expenditure, and are closely related to basal metabolism, requirements are also expressed as multiples of BMR.

1.6- Energy requirements

Energy needs depend on age, weight, and physical activity. The FAO publishes recommended energy intakes by age group, gender and physical activity

DAILY RECOMMENDED INTAKES FOR ENERGY

SEX/AGE	BODY WEIGHT	ENERGY	
Years	kg	kcal	MJ
BOTH SEXES			
0-6 months	6.0	524	2.19
6-11 months	8.9	708	2.97
1-3	12.1	1 022	4.28
4-6	18.2	1 352	5.66
7-9	25.2	1 698	7.10
GIRLS			
10-17	46.7	2 326	9.73
SEX/AGE	BODY WEIGHT	ENERGY	
Years	kg	kcal	MJ
BOYS			
10-17	49.7	2 824	11.81
WOMEN	55.0		
18-59		2 408	10.08
Pregnant		+278	+1.17
Breastfeeding		+450	+1.90
60 and over		2 142	8.96
MEN	65.0		
18-59		3 091	12.93
60 and over		2 496	10.44

Sources: Energy - FAO. 2004. Energy in human nutrition. Report of a Joint FAO/WHO/UNU Expert Consultation. FAO Food and Nutrition Technical Paper Series, No. 1. Rome; Protein - WHO. 1985. Energy and protein requirements. Technical Report Series 724. Geneva; Micronutrients - FAO/WHO. 2002. Human vitamin and mineral requirements. Report of a Joint FAO/WHO Expert Consultation. Rome.

2- PROTEIN REQUIREMENT (Essential and Non-essential Amino Acids)

Proteins constitute the skeleton around which the cell arranges itself, according to a rigorous composition. Certain proteins have particular physiological roles: producing skin and hair, the material that contracts muscles, constitution of enzymes, anti-bodies and hormones...
This is why proteins are absolutely necessary for life.
Proteins are needed for: maintenance, growth, reparation, pregnancy and lactation.

Protein food also is used to cover energy requirements but its main role is the formation of **amino acids,** necessary for the complete synthesis of cells.

Protein foods **Amino Acids** **Proteins in the Body**

Digestion Synthesis of Proteins

2.1- Essential Amino Acids

Twenty Amino Acids are used by the organism. They can be classed into two categories:
- Amino Acids which can be synthesised by man or **Non-essential Amino Acids.**

- Amino Acids which cannot be synthesised by man or **Essential Amino Acids**. There are 8 of these in total:
Phenylalanine, Tryptophan, Methionine, Lysine, Leucin, Isoleucine, Valine and Threonine.
There is a ninth essential amino acid for the infant in the first few months of life, this is **Histidine**.
Essential Amino Acid intake is particularly important.

2.1.1- Balanced Intake - a limiting factor.

All the appropriate Amino Acids should be present in adequate proportions to satisfy the needs for protein synthesis. If a single amino acid exist but in an insufficient quantity, it becomes a **limiting factor**, meaning the synthesis is halted even with all the other amino acids present until the least abundant exists in the correct quantities.
The most common limiting factors are:

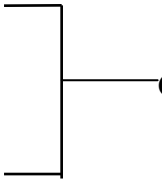
* **Lysine** from cereals and their derivatives
* **Methionine** from legumes and foods of animal origin

Animal proteins contain adequate quantities of Essential Amino Acids.

2.1.2- Supplementation / Combination / Complementation

If a protein which is poor in a particular Amino Acid is combined with a protein rich in that same Amino Acid, the biological value of the combination is improved: this practice is called supplementation.

E.g. Rice + Meat
Fish + Maize
Peanuts and Millet
Maize, Rice + Peanuts
Soya or Beans



Complement each other

2.2- Estimation of Protein requirements

- Requirements: level to safely cover 97.5% of the population to be covered.

- For children: (see tables 5 and 6)

- For adults: to securely cover protein requirements the level has been fixed at 0.75g/kg/24 hr of high quality protein.

- For pregnant women: The supplement of protein corresponding to the safe level is 6g/day of high quality proteins throughout the entire pregnancy.

- For Lactating Women: 16g of protein per day should be added during the first 6 months of breastfeeding, and 12g/day during the second half of the first year.

The utilisation of protein depends on the energy supply
Proteins are used more efficiently, if a sufficient quantity of energy is supplied by the ration. An inadequate energy supply could, like protein deficiency, be the cause of a negative nitrogen balance.

Conclusion

Energy supplied by proteins should represent 10 to 15 % of the total energy value of the ration.

The organism does not make real stores of protein.

All Amino Acids which are not used by the body, either because of an excess, or because they are not of the correct quality, are «burned», as a source of energy.

Table 5: Security level of proteins for infants and children aged 3 months to 10 years (both sexes combined until 5 years)

Age [3]	Median Weight in kg	Safe Levels	
		g / kg	g / day
3 - 5 months	7	1.85	13
6 - 8 months	8.5	1.65	14
9 - 11 months	9.5	1.50	14
12 - 23 months	11	1.20	13.5
24 - 35 months	13.5	1.15	15.5
36 - 59 months	16.5	1.10	17.5
5 - 6 years	20.5	1.00	21
7 - 9 years	27	1.00	27

Source WHO: Technical Report Series 724

Table 6: Safe Levels of proteins for Adolescents aged 10 - 18 years

Age	Median Weight in kg	Median Height in cm	Safe Level of Protein	
			g / kg	g / day
Boys				
10 -11 years	34.5	144	1.0	34
12 - 13 years	44	157	1.0	43
14 - 15 years	55.5	168	0.95	52
16 - 17 years	64	176	0.9	56
Girls				
10 -11 years	36	145	1.0	36
12 - 13 years	46.5	157	0.95	44
14 - 15 years	52	161	0.9	46
16 - 17 years	54	163	0.8	42

Source WHO: Technical Report Series 724

3- LIPID REQUIREMENTS

Lipids are the constituents of fats, both animal and vegetable, which are mainly composed of fatty acids.

[3] Age in whole months or years

Lipids play a role in the metabolic and structural balance of the body (cell membranes of organs and tissues, the nervous system). They also constitute important energy stores, in the form of adipose tissue.

A number of the fatty acids, which make up lipids, must be supplied by the diet, since they cannot be synthesised by the human body. This being some of the **poly-unsaturated fatty acids (PUFA)** which are essential; the two major ones being lineoleic and linolenic acid. A deficiency in the dietary supply of essential fatty acids (EFA) (especially linoleic acid) provokes metabolic disturbances. This affects both old and young, although the later in particular.

Lipid intake is also important for the supply of lipid soluble vitamins (such as vitamins A and E). Lipids should represent a minimum of 15% and a maximum 30% of total energy. EFA's should represent at least 3% of total energy supply.

4- CARBOHYDRATE REQUIREMENTS

Along with the lipids, carbohydrates supply most of the energy used and stored by the organism.
Carbohydrates are the sugars:
- Complex: slow (starches): these are the cereals, roots and tubers
- Simple: rapid: these are the sugars and their derivatives, milk sugar (lactose) or fruit sugar (fructose)

Sugar is essential for the production of energy in the brain (the brain only uses glucose, with the sugar molecule).

5- WATER AND ELECTROLYTE REQUIREMENTS

70 - 80% of the body is water. Water is by far the most important constituent of the body (present in all of the tissues). Water has various functions in the organism:

- Water is a vehicle and a solvent
- Water is a product of metabolic reactions
- Water is an element of temperature regulation

Water requirements vary according to: relative humidity, external temperature, physical activity, weight (70% water) and age.

Water requirements are as follows:

 Infants: - 0 - 3 months: 150 ml/kg/day
- 3 - 6 months: 125 ml/kg/day
- 6 - 12 months: 110 ml/kg/day

Water requirements for infants are supplied by maternal milk or milk substitutes.

 Older children, adolescents and adults: 35 to 45 ml/kg/day based on life in a temperate climate with moderate physical activity.

About half of this is supplied by drinks, the other half, by water contained in food and the water produced by the organism during oxidation reactions. Water requirements increase in people carrying out heavy muscular work (professional activity or sport) especially in warm climates or environments, (summer or tropical areas).

Water metabolism is closely linked to that of the electrolytes, especially sodium.

6- VITAMIN REQUIREMENTS

6.1- Definitions

 Vitamins

Vitamins are organic substances, without energetic value as such, necessary for the function of the body or for growth and are effective in very low doses. Hypovitaminosis (Vitamin deficiency, clinical signs often appearing late) have the common characteristic of being cured when the individual starts to consume the missing vitamin.

To cover requirements, this can be done over a period of time, not being necessary on a day by day basis. The requirements are established for an 'average person' in a population, variations, sometime significant, exist between individual people.

6.2- Vitamin A - Retinol

* Role:
  - in vision
  - essential for growth and for differentiation control of epithelial cells (conjunctiva, cornea, bronchia, intestine)
  - in bone growth, the synthesis of certain steroid hormones (progesterone),
  - the immune system (resistance to infection).

* Main Natural Sources:

The main natural sources are animal in origin: liver, egg yolk, fish, whole milk, butter, cheese.

The precursors of the vitamin, such as certain carotenoids, are present in many fruits and vegetables. The most abundant carotenoid is beta-carotene (Provitamin A), it is present in carrots, green vegetables, pumpkin, broccoli, melon, eggs and butter. Food is the unique source of vitamin A.

* Units:

Vitamin A activity is expressed in 'Retinol Equivalents', or RE.

1 RE = 1 µg of Retinol = 3.31 IU = 6 µg of beta carotene = 12 µg of other carotenoids.

* Stability:

Vitamin A will be oxidised on contact with air or light, it is destroyed when present in fats if they themselves are oxidised. It is stable when heated, although there are losses during prolonged boiling. Combination of antioxidants (such as Vitamin E) protects vitamin A.

* Main interactions:

Oral Contraceptives can slightly decrease the hepatic reserves of Vitamin A. Infectious diseases and parasitic infestations decrease Vitamin A reserves and conversely an insufficient intake of Vitamin A decreases the resistance to disease. An acute protein deficiency disturbs Vitamin A metabolism, a diet low in fat decreases the absorption of Vitamin A and carotenoids. Vitamin A deficiency can cause anaemia. Vitamin E protects Vitamin A.

* Recommended Nutrient Intakes:

Estimated mean requirement and safe level of intake for vitamin A

Age group	Mean requirement μg RE/day	Recommended safe intake μg RE/day
Infants and children		
0–6 months	180	375
7–12 months	190	400
1–3 years	200	400
4–6 years	200	450
7–years	250	500
Adolescents, 10–18 years	330–400	600
Adults		
Females, 19–65 years	270	500
Males, 19–65 years	300	600
65+	300	600
Pregnant women	370	800
Lactating women	450	850

Source: Adapted from FAO/WHO, Rome 1988 (69).

* Deficiency:
It is the main cause of blindness. The symptoms are a decrease in visual acuity in the half light (dusk) and appearance of cutaneous lesions. Vitamin A deficiency is often associated with other factors such as malnutrition or infections, the deficiency can be the cause of high mortality rates.

Xerophthalmia [4]Prevention programmes in the third world focus mainly on children between the age of 6 months and 7 years. It is mostly children 6 months to year who have vitamin A deficiencies. Vitamin A is stored in the liver and it is possible to constitute a reserve by giving high doses orally 2 to 3 times a year:

100,000 IU for children aged 6 months to one year old
200,000 IU for children over a year
200,000 IU for mothers after the birth
Pregnant women are advised not to take more than 10,000 IU per day

Deficiencies can be the cause of excessive infant and child mortality, even if there are no apparent symptoms of a deficiency. This has been shown in hospitals, where mortality due to measles could be reduced by giving Vitamin A supplements. This might also apply to other diseases like diarrhoea.
Vitamin A capsules also contain Vitamin E.

* Overdose:
Accidental overdose of Vitamin A have been observed for doses 20 to 50 times higher than recommended intakes. There are risks of congenital malformation due to overdose during pregnancy. It is for this reason that the use of capsules of 200,000 IU of Vitamin A is not advised during pregnancy.

[4] Xerophthalmia means dry eye. It as a condition that affects the cornea and the conjunctiva, by diminishing the lacrymal secretions which usually cover the conjunctiva and the cornea.

BETA CAROTENE or Provitamin A

* Main Natural Sources:
Vegetables and coloured fruits (Yellow, red and green) contain a lot of beta carotene, but the amount depends on the season and their maturity.

* Units / Conversion Factors
1 Retinol Equivalent = 1 µg of Retinol (Vitamin A)
= 6 µg of beta carotene
= 3.31 IU of Vitamin A
= 12 µg of other carotenoids

* Recommended Nutrient Intakes:
The recommended food intakes of beta carotene are just until present incorporated into those of Vitamin A.

* Risk groups for low levels
Smokers, Drinkers, women who take oral contraceptives and people on low incomes, consuming little fresh produce.

* Stability
Dehydration of the fruits and vegetables can greatly reduce the vitamin levels, as well as preservation by freezing.

6.3- B- Complex Vitamins

The B-complex vitamins play a role in the composition of enzymic systems necessary for life. Physiologic roles and deficiency signs of B-complex vitamins are presented in the following table:

Vitamin	Physiologic roles	Deficiency
Thiamin (B1)	Co-enzyme functions in metabolism of carbohydrates and branched-chain amino acids	Beri-beri, polyneuritis, and Wernicke-Korsakoff syndrome
Riboflavin (B2)	Co-enzyme functions in Numerous oxidation and reduction reactions	Growth, cheilosis, angular stomatitis, and dermatitis
Niacin (nicotinic acid and nicotinamide)	Co-substrate/co-enzyme for hydrogen transfer with numerous dehydrogenases	Pellagra with diarrhoea, dermatitis, and dementia
Vitamin B6 (pyridoxine, pyridoxamine, pyridoxal)	Co-enzyme functions in metabolism of amino acids, and glycogen, and sphingoid bases	Naso-lateral seborrhoea, glossitis, and peripheral neuropathy (epileptiform convulsions in infants)
Pantothenic acid	Constituent of co-enzyme A and phosphopantetheine involved in fatty acid metabolism	Fatigue, sleep disturbances, impaired coordination, and, nausea
Biotin	Co-enzyme functions in bicarbonate-dependent carboxylations	Fatigue, depression, nausea, dermatitis, and muscular pains

Source: Report of a joint FAO/WHO expert consultation on human vitamin and mineral requirements

6.3.1- Vitamin B1 - Thiamin - anti beriberi factor - anti neuritis factor - aneurine

* Role

Essential in carbohydrate metabolism. Also plays a role in the transmission of nerve impulses and in the respiratory chain.

* Main Natural Sources

Pork, dried vegetables, milk and eggs are relatively rich in this vitamin. The thiamin in cereals is mainly contained in the outer husk of the grain.

* Stability

Thiamin is sensitive to heat, alkaline environments, oxygen and light. Normal cooking destroys around 25% of the thiamin content of foods. For thiamin, it is recommended to keep the cooking time to a minimum, in a covered pan with the least quantity of water. The use of

the juice and the cooking water in stocks and sauces allows a part of the vitamin to be recovered.

* Main Interactions
A certain number of foods can act as B1 antivitamins: coffee, tea, raw fish and certain cereals.

* Recommended Nutrient Intakes

Recommended nutrient intakes for thiamin

Group	Recommended nutrient intake mg/day
Infants and children	
0–6 months	0.2
7–12 months	0.3
1–3 years	0.5
4–6 years	0.6
7–9 years	0.9
Adolescents, 10–18 years	
Females	1.1
Males	1.2
Adults	
Females, 19+ years	1.1
Males, 19+ years	1.2
Pregnancy	1.4
Lactation	1.5

Source: Report of a joint FAO/WHO expert consultation on human vitamin and mineral requirements

* Deficiency:
- Minor deficiency: A marginal deficiency can intervene under diverse circumstances: pregnancy / lactation, high consumption of carbohydrates, intense physical activity, certain illnesses (dysentery, diarrhoea), regular consumption of alcohol....
A supplementary intake of thiamin is therefore necessary.

- Total deficiency: Two Illnesses due to B1 deficiency are known:
◎ Beriberi:
Manifested by neurological and cardio vascular problems, three forms exist:
- *dry form*: characterised by polyneuritis with severe muscle wasting
- *wet form*: with oedema, anorexia, muscle weakness, mental confusion, and the final stage cardiac insufficiency.
- *infantile form*: whose symptoms (vomiting, convulsions, abdominal distension, anorexia) appear very suddenly and cause death from cardiac arrest.

◎ Gayet - Wernicke - Korsakoff Syndrome:
It is more common. It can be found in people who regularly fast or vomit. The symptoms range from confusion and mild depression to psychosis and coma.

* Overdose
Thiamin is used to compensate for the deficiency signs of Vitamin B1. Vitamin B1 is well tolerated in health people, even in high doses. The oral security margin / range is large: up to 100 times the recommended daily intake.

6.3.2- Vitamin B2 - Riboflavin

* Role
Occurs in the many metabolic reactions of carbohydrates, lipids and protein as well as in the production of energy in the respiratory chain (Krebs cycle).

* Main Natural Sources
The richest sources are yeast and liver. The most common dietary sources however are milk and milk products, meat eggs, dark green leafy vegetables and a small quantity in cereals. Riboflavin of animal origin is absorbed better.

* Stability
Riboflavin is resistant to heat, but is sensitive to light. It can be lost in the cooking water of foods.

* Main Interactions
Oral contraceptives have a negative influence on the absorption, the transport and the metabolism of riboflavin.

* Recommended Nutrient Intakes

Recommended nutrient intakes for riboflacin

Group	Recommended nutrient intake mg/day
Infants and children	
0–6 months	0.3
7–12 months	0.4
1–3 years	0.5
4–6 years	0.6
7–9 years	0.9
Adolescents, 10–18 years	
Females	1.0
Males	1.3
Adults	
Females, 19+ years	1.1
Males, 19+ years	1.3
Pregnancy	1.4
Lactation	1.6

Source: Report of a joint FAO/WHO expert consultation on human vitamin and mineral requirements

* Deficiency
Minor deficiency: Generally associated with the deficiency of various B group vitamins. It can cause growth retard in children.

Total Deficiency: The symptoms are crimson red tongue with taste bud atrophy, shiny dry lips, abnormally red, sometimes chapped and scabby, fissures in the corners of the mouth, itching sebhorrea dermatitis with eruption and hyperpigmentation especially around the scrotum. Riboflavin deficiency is also accompanied by ocular symptoms, hypervascularisation of the conjunctiva, itching, photophobia, and watery eyes.

* Overdose
No secondary effects have been observed after excessive ingestion of riboflavin.

6.3.3- Niacin B3 - Vitamin B3 - Vitamin PP

* Role
Necessary for growth and is present / involved in the synthesis of hormones

* Main Natural Sources
Yeast, Liver, nuts, and pulses. Also poultry, lean meat and offal, fish are the largest dietary sources of Niacin.
Tryptophan is an Amino Acid precursor of niacin. Tryptophan is found in meat, milk and eggs.

1 Niacin Equivalent (NE) = 1 mg Niacin = 60 mg Tryptophan

* Main Interactions
The transformation of Tryptophan to Niacin can be affected by a deficiency of copper or Vitamin B6 (Pyridoxine).

* Recommended Nutrient Intakes

Recommended nutrient intakes for niacin

Group	Recommended nutrient intake NEs/day[5]
Infants and children	
0–6 months	2[6]
7–12 months	4
1–3 years	6
4–6 years	8
7–9 years	12
Adolescents, 10–18 years	16
Adults	
Females, 19+ years	14
Males, 19+ years	16
Pregnancy	18
Lactation	17

Source: Report of a joint FAO/WHO expert consultation on human vitamin and mineral requirements

* Deficiency
The signs of deficiency are non specific. Total deficiency leads to pellagra whose symptoms are dermatitis, dementia, diarrhoea, and nervous problems.
It causes skin lesions especially around the wrists, elbows and neck. A characteristic glossitis and stomatitis can be present. Nausea and Vomiting can lead to a precocious stage. Deficiency can also lead to paralysis of the extremities in particular the legs.

[5] NEs, niacin equivalents.
[6] Preformed

People at risk of niacin deficiency are those with an increased Niacin requirement, during pregnancy, lactation, cancer patients, users of oral contraceptives, and in patients deficient in protein.

* Security Margin
Doses of 30 mg to over 100 mg are considered harmless. Prolonged use of very high doses should be under medical surveillance.

6.3.4- Pantothenic Acid - Vitamin B5

* Role
Essential for the preservation and repair of cells and tissues.

* Main Natural Sources
Yeast, offal (liver, kidney, heart, brain), meat, eggs, fish, milk, vegetables and wholegrain cereals.

* Stability
Pantothenic Acid is destroyed by heat in alkaline or acidic solutions.

* Main Interactions
Various studies have shown that Vitamin B12 appears to facilitate the conversion of Pantothenic Acid to Coenzyme A (vitamin A is one of the components of coenzyme A, which is necessary for the combustion of fatty acids and carbohydrates in the cell and for the transformation of carbohydrates into fatty acids). Other experiments have shown that Ascorbic Acid decreases the severity of symptoms due to Pantothenic Acid deficiency.
* Recommended Nutrient Intakes

Recommended nutrient intakes for pantothenic acid

Group	Recommended nutrient intake mg/day
Infants and children	
0–6 months	1.7
7–12 months	1.8
1–3 years	2
4–6 years	3
7–9 years	4
Adolescents, 10–18 years	5
Adults	
Females, 19+ years	5
Males, 19+ years	5
Pregnancy	6
Lactation	7

Source: Report of a joint FAO/WHO expert consultation on human vitamin and mineral requirements

* Deficiency
Pantothenic acid, being widespread in foods, makes deficiency exceptional and never total. It is therefore difficult to formulate a specific clinical table.

Experimental deficiency associating a diet with a pantothenic acid antagonist, show more or less specific symptoms appearing after two to three weeks.
General, digestive, cutaneous and neurological signs are observed:

- **General Signs**: Asthenia is observed
- **Digestive Signs**: nausea, vomiting, diarrhoea, and abdominal pain are associated. duodenitis or gastro-duodenal ulcers can exist.
- **Cutaneous Signs**: Alopecia and cutaneous ulcers
- **Neurological Signs**: Associated headache, insomnia, depression, parethenia, pain and burning in the extremities.

'Burning Feet' syndrome, observed in Japan and the Philippines during the second world war, is considered by some as a specific sign of pantothenic acid deficiency. This syndrome was recently observed in refugees in Afghanistan eating a diet based on highly refined flour.
Anomalies of certain synthesis have been recorded: cholesterol and corticosteroids, ketone bodies, antibodies.

* Overdose
No case of hypervitaminosis B5 has been observed to date.

6.3.5- Vitamin B6 - Pyridoxine

* Role
Essential for the metabolism of Essential Amino Acid's and proteins.

* Main Natural Sources
Vegetables, meat, poultry, fish, liver, kidney, oil products, milk products, bread, cereal grains.

* Stability
Stable to heat, but susceptible to oxidation with light and alkaline environments.

* Recommended Nutrient Intakes

Recommended nutrient intakes for vitamin B6

Group	Recommended nutrient intake mg/day
Infants and children	
0–6 months	0.1
7–12 months	0.3
1–3 years	0.5
4–6 years	0.6
7–9 years	1.0
Adolescents, 10–18 years	
Females	1.2
Males	1.3
Adults	
Females, 19-50 years	1.3
Males, 19-50 years	1.3
Females > 50 years	1.5
Male > 50 years	1.7
Pregnancy	1.9
Lactation	2.0

Source: Report of a joint FAO/WHO expert consultation on human vitamin and mineral requirements

* Deficiency

Minor deficiency: It is rare that dietary intakes of Vitamin B6 provoke well defined signs of deficiency.

Total Deficiency: A diet too low in Vitamin B6 can provoke hypochromic anaemia and a decrease in the capacity of the organism to transform Tryptophan to nicotinic acid. People susceptible to hypoviatminosis B6 are pregnant and lactating women, women taking high oestrogen dose oral contraceptives, and people whose diet is rich in proteins are also at risk of hypovitaminosis B6.

* Therapeutic Indications:

Pyridoxine deficiency of genetic origin cause certain forms of anaemia as well as anomalies in Amino Acid metabolism. The therapeutic dose is between 40 and 200 mg / day.

A preventive treatment can be prescribed to pregnant and lactating women and those taking oral contraceptives.

* Overdose

Doses over 50 - 100 times the recommended intakes can be prescribed but not more.

6.3.6- Biotin - Vitamin H - Vitamin B8

* Role

Essential to normal growth and function of the body. Plays a key role in the metabolism of carbohydrates, lipids and proteins.

* Main Natural Sources

Yeast, liver, kidney, egg yolk, soya, different types of nuts and cereals.

* Stability
Biotin is relatively stable.

* Main Interactions
Consumption of large quantities of raw egg white over long periods of time can provoke a deficiency of Biotin.

* Recommended Nutrient Intakes

Recommended nutrient intakes for biotin

Group	Recommended nutrient intake µg/day
Infants and children	
0–6 months	5
7–12 months	6
1–3 years	8
4–6 years	12
7–9 years	20
Adolescents, 10–18 years	25
Adults	
Females, 19+ years	30
Males, 19+ years	30
Pregnancy	30
Lactation	35

Source: Report of a *joint FAO/WHO expert consultation on human vitamin and mineral requirements*

* Deficiency
To demonstrate the symptoms volunteers consumed a diet deficient in biotin and rich in raw egg white, after 3 to 4 weeks, they acquired lightly coloured flaky skin, although not itchy. After 10 weeks, they were tired, depressed, sleepy, nauseous and lacking appetite. They suffered muscular pain and troubles of sensibility, without modification of reflexes and without other neuropathological signs. Their tongues were pale, with disappearance of taste buds. Their skin was rich and squameuse, the appearance of anaemia and hypercholesterolaemia was noted.

* Therapeutic Indications
Treatment of Biotin deficiency uses doses of 5 to 20 mg / day.

* Security Margins
No risk of toxicity in high doses.

6.4- Folic acid - Vitamin B9

* Role
Necessary for growth and the function of the nervous system and bone marrow.

* Main Natural Sources

Liver, dark green leafy vegetables, beans, wheat grain and yeast. It is also found in other vegetables, egg yolk, cheese, orange juice and wholemeal bread.

* Stability
Folic acid is unstable to cooking and to storage at ambient / room temperatures.

* Main Interactions
Oral contraceptives decrease the absorption of folic acid.

* Recommended Nutrient Intakes

Estimated average requirement (EAR) and recommended nutrient intake (RNI) for folic acid expressed as dietary folate equivalents, by age group

Group	EAR (µg/day)	RNI (µg/day)
Infants and children		
0–6 months	65	80
7–12 months	65	80
1–3 years	120	160
4–6 years	160	200
7–9 years	250	300
Adolescents, 10–18 years	300	400
Adults		
19-65 years	320	400
+65 years	320	400
Pregnancy	520	600
Lactation	450	600

Source: Report of a *joint FAO/WHO expert consultation on human vitamin and mineral requirements*

* Deficiency
Hypovitaminosis of folic acid is the most common vitamin deficiency. The first symptoms of tiredness, irritability and loss of appetite are not specific.
Loss of appetite, abdominal pain, nausea and diarrhoea can be observed in acute deficiency. Painful ulcers can develop in the mouth and pharynx. Cutaneous discoloration and hair loss are equally possible. In pregnant women, the deficiency can cause premature birth or malformation of the new born (spina-bifida).In childhood, the deficiency is characterised by a late puberty and a retarded growth.

Deficiency of folate intake is still common in developing countries, combined in particular with iron deficiency. Deficiency of folate absorption is observed in all illnesses involving reduction of the surface or ability of absorption such as short intestinal resection, coeliac disease, Chron's disease. These pathologies also often provoke the combined malabsorption of Vitamin B12 and iron.

* Therapeutic Indications
A multivitamin preparation can be used containing around 400 - 500 µg of folic acid, if there is a serious risk of deficiency.
Supplements can be given to pregnant women.

* Overdose
No risk of toxicity at high doses.

6.5- Vitamin B12 - Part of Cobalamine family

* Role
Necessary for the formation of red blood cells, cells of the nerve ducts and various proteins. Also participates in the metabolism of lipids and carbohydrates. This vitamin is essential for growth.

* Main Natural Sources
Offal (Liver, kidney, heart, brain), meat, poultry, fish, eggs and milk products. Foods of vegetable origin are a poor source of vitamin B12.

* Stability
Vitamin B12 is sensitive to light, oxygen, reducing agents, acidic or alkaline mediums, but is stable to heat. Loss of activity during cooking is due to the passage of Vitamin B12 into the meat juices or into the cooking water.

* Recommended Nutrient Intakes

Estimated average requirement (EAR) and recommended nutrient intake (RNI) for vitamin B12, by age group

Group	EAR (µg/day)	RNI (µg/day)
Infants and children		
0–6 months	0.32	0.4
7–12 months	0.32	0.4
1–3 years	0.7	0.9
4–6 years	1.0	1.2
7–9 years	1.5	1.8
Adolescents, 10–18 years	2.0	2.4
Adults		
19-65 years	2.0	2.4
+65 years	2.0	2.4
Pregnancy	2.2	2.6
Lactation	2.4	2.8

Source: Report of a *joint FAO/WHO expert consultation on human vitamin and mineral requirements*

* Deficiency
The symptoms are very similar to those observed in folic acid deficiency. This deficiency is essentially due to problems of absorption. It is rarely dietary in origin. On the other hand, Vitamin B12 deficiency is a common problem for vegetarians.

* Overdose
No risk of toxicity seen in doses up to 30,000 times the recommended daily intake.

6.6- Vitamin C - Ascorbic Acid

* Role

Necessary for the production of collagen (connective tissue protein). Repair of structures rich in connective tissue (bone, cartilage, ligaments, capillary vessels....). Contributes to the health of the gums and teeth. Aids the absorption of iron.

* Main Natural Sources

Citrus fruits, potatoes, cauliflower, broccoli, brussels sprouts, parsley, sweet peppers, blackcurrants, certain exotic fruits.

* Stability

Sensitive to heat, light and oxygen. Prolonged storage and overcooking almost completely destroy vitamin C.

* Recommended Nutrient Intakes

Recommended nutrient intakes (RNIs) for vitamin C

Group	**RNI mg/day**
Infants and children	
0–6 months	25
7–12 months	30
1–3 years	30
4–6 years	30
7–9 years	35
Adolescents, 10–18 years	40
Adults	
19-65 years	45
+65 years	45
Pregnancy	55
Lactation	70

Source: Report of a *joint FAO/WHO expert consultation on human vitamin and mineral requirements*

* Deficiency

Deficiency symptoms are tiredness, lassitude, loss of appetite, somnolence, insomnia, irritability, low resistance to infections and the appearance of haemorrhages at capillary level. The total deficiency causes scurvy. The first signs of which, in general are bleeding gums and loss of teeth. Sub cutaneous haemorrhages cause hypersensitive extremities and painful movements. If scurvy is not treated in time with a sufficient Vitamin C intake, it will result in gangrene and can cause death. NB. Scurvy is painful which is not the case with rickets.

* Therapeutic Indications

Main Indication is to prevent real deficiency; that is scurvy, as well as insufficient intakes (tabagasme: pregnant or lactating women). In fact, 10 - 15 mg / day of Vitamin C is sufficient to prevent scurvy.

It should be noted that a tomato (on the condition that it is fresh) represents enough Vitamin C for one week. Cases of scurvy are regularly reported in African camps where there is no access to fresh produce.

* Overdose
There is no risk for high doses.

6.7- Vitamin D - Calciferol

* Role
Important for the function of the muscles and nerves, coagulation of the blood, cellular growth and the use of energy.

* Main Natural Sources
Fish oils and oily fish (sardines, herring, salmon, mackerel), eggs, meat, milk and butter.

* Units
Vitamin D activity is expressed in IU or in micrograms.
1 IU = 0.025 µg of cholecalciferol

* Stability
It is relatively stable in foods. Only exposure to light can cause greater losses.

* Recommended Nutrient Intakes

RNIs for vitamin D according to age groups

Group	**RNI µg/day**
Infants and children	
0–6 months	5
7–12 months	5
1–3 years	5
4–6 years	5
7–9 years	5
Adolescents, 10–18 years	5
Adults	
19-50 years	5
Older adults 51-65 years	10
Elderly adults + 65 years	15
Pregnancy	5
Lactation	5

Source: Report of a *joint FAO/WHO expert consultation on human vitamin and mineral requirements*

* Deficiency
It can be seen in the form of muscle weakness, tetanus and an increase in the risk of infection. Manifestations of Vitamin D deficiency are **rickets** in children and **osteomalacia** in adults, particularly in menopausal women. The risk of deficiency can be due to fat malabsorption or a very low exposure to sunlight.

* Therapeutic Indications
Doses can be very high at the start of the treatment (75 - 100 µg / day that it 3000 - 4000 IU), the doses are then reduced to 1 or 2 times the recommended nutrient intake for long term maintenance.

* Overdose
For Adults, the toxic dose is around 2.5 mg (100 000 IU) / day during 1 or 2 months.
For Children, it can be between 0.5 mg (20 000 IU) and 1.0 mg (40 000 IU).
Certain people who are very sensitive to Vitamin D can show signs of toxicity at much lower doses.
Prophylactic doses of 1000 IU / day in the infant and of 5000 to 10 000 IU in the adult are considered to be harmless.
Hypervitaminosis has no relation, with excessive exposure to the sun.

6.8- Vitamin E - Tocopherol

* Main Natural Sources
Wheat grain, green vegetables, salad, cabbage, spinach, oil seeds.

* Recommended Nutrient Intakes
Vitamin E requirements for infants are 5IU.
At present, data are not sufficient to formulate recommendations for vitamin E intake for different age groups except for infancy.
No specific recommendations concerning the vitamin E requirements in pregnancy and lactation have been made mainly because there is no evidence of vitamin E requirements different from those of other adults and presumably also as the increased energy intake would compensate for the increased needs for infant growth and milk synthesis.

* Units
1 IU corresponds to 1 mg of t/x tocopherol acetate

* Deficiency
Vitamin E deficiency can be observed in the new-born, especially premature infants, presenting in the form of haemolytic anaemia. Deficiency is more frequent, since the vitamin E reserves are practically non existent at this stage of life.
* Therapeutic Indications and Dosage
Vitamin E is prescribed in cases of insufficient spermatogenesis. Lower doses (100 to 200 mg / day) are proposed for the treatment of sterility, dysmenhorrea and functional menopausal problems. Vitamin E has remarkable antioxidant properties.

* Overdose
The security margins for high doses are excellent.

6.9- Vitamin K

* Role
Essential for the coagulation of blood (avoids internal or external haemorrhage)

* Main Natural Sources

Spinach, cabbage, cauliflower, broccoli, green salad, Soya grains, beef liver, green tea, egg yolk and cheeses.

* Recommended Nutrient Intakes

Recommended nutrients intakes for vitamin K

Group	Recommended Nutrient Intake µg/day
Infants and children	
0–6 months	5*
7–12 months	10
1–3 years	15
4–6 years	20
7–9 years	25
Adolescents, 10–18 years	
Females	35-55
Males	35-55
Adults	
Females 19-65 years	55
+ 65 years	55
Males 19-65 years	65
+ 65 years	65
Pregnancy	55
Lactation	55

*This intake cannot be met by infants who are exclusively breast-fed.
Source: Report of a joint FAO/WHO expert consultation on human vitamin and mineral requirements

* Deficiency

Vitamin K deficiency provokes haemorrhages. Dietary deficiencies of Vitamin K are rare.
This deficiency can appear in low birth weight new-born or in premature infants not supplemented with Vitamin K at birth.
People at risk of this deficiency are therefore those where an injection of Vitamin K is not obligatory at birth. This deficiency does not exist in Europe since the vitamin K injection is given at birth.

* Stability

It is stable to heat and to reducing agents. Is sensitive to light, acids, bases and to oxidising agents.

N.B.: All the information on the different vitamins were collated from "Human Vitamin and Mineral Requirements" / Report of a joint FAO/WHO expert consultation Bangkok, Thailand / WORLD HEALTH ORGANIZATION FOOD SND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS Rome, 2002

7- MINERALS AND TRACE ELEMENTS

7.1 Calcium

Role: Principally, in the mineralisation of bone, but also in the coagulation of blood and muscle contractions.

Food Sources: (Source: Food and Human Nutrition. H.Dupin; JL. Cuq; MI. Malewiak;C. Leynaud-Rouaud; A-M. Berthier.)
All milk products, dried fruits, fish, white bread. Meats are a poor source for calcium.

Calcium Deficiency: (Source: Treating Child Nutrition. C.Ricour; J. Ghisolfi; G.Putet; O. Goulet.)
Severe calcium deficiency (less than 300gmg per day) induces a long series of difficulties in the metabolism of phosphocalcium. This has been studied by Pettifor in South Africa. Once calcium deficiency is present it induces secondary 'hyperparathyroid' and therefore 'hyperphosphaturie' and 'hyperphosphatemie'.
This association encourages rickets and osteomalacia (reduced mineralisation of the bone). The children have serious deformation of the lower limbs but neither muscular fatigue nor pain in the bone exist at this time.
The simple solution is a diet of 1000mg of calcium per day and 800mg of phosphorus. This is sufficient to correct the biological, radiological and clinical alterations. The effects of this deficiency are significantly aggravated by diets containing high levels of protides or sodium.

Recommended Nutrients Intakes:

Recommended, calcium allowances based on Western European American and Canadian data

Group	Recommended Intake mg/day
Infants and children	
0–6 months	
Human milk	300
Cow milk	400
7–12 months	400
1–3 years	500
4–6 years	600
7–9 years	700
Adolescents, 10–18 years	1300
Adults	
Females	
19 years to menopause	1000
Postmenopause	1300
Males 19-65 years	1000
+ 65 years	1300
Pregnancy (last trimester)	1200
Lactation	1000

Source: Report of a joint FAO/WHO expert consultation on human vitamin and mineral requirements

7.2- Zinc

Role: Very important to the immunity, necessary for weight growth and development during puberty; plays a role in pro-insulin storage; occurs in many enzyme reactions.

Food Sources: (Source: Treating Child Nutrition. C.Ricour; J. Ghisolfi; G.Putet; O. Goulet.)

Zinc is everywhere in human food where there is a connection with proteins.
Recommended Nutrients Intakes (European):

Recommended zinc intake

Group	**Recommended intake mg/day**
Infants and children	
6–11 months	4
1–3 years	4
4–6 years	4
7–10 years	7
Adolescents,	
Females 11-14 years	9
Females 15-17 years	7
Males 11-17 years	9
Adults	7
Pregnancy	7
Lactation	12

Deficiency: (Source: Treating Child Nutrition. C.Ricour; J. Ghisolfi; G.Putet; O. Goulet.)
The clinical table is remarkably constant, dominated by growth retardation, reversible by the administration of zinc. Deficiency in zinc is normally associated with:
-Profound anorexia,
-Growth retardation,
-Skin and 'occulaores' lesions,
-Prolonged diarrhoea
-Increased susceptibility to infection: serious disruption to the immune system, particular that section dependant on lymphocytes T.

7.3- Copper

Role : essential in enzymatic systems

Natural Sources: (Source: Treating Child Nutrition. C.Ricour; J. Ghisolfi; G.Putet; O. Goulet.)

Oysters, walnut, cocoa, liver and kidney offal, margarine and maize oil, also dried fruits are rich in copper.

Recommended Nutrients Intakes:

Recommended copper intake

Group	Recommended intake mg/day
Infants and children	
6–11 months	0.3
1–3 years	0.4
4–6 years	0.6
7–10 years	0.7
11-14 years	0.8
15-17 years	1.0
Adults	1.1
Pregnancy	1.1
Lactation	1.4

The needs of copper are largely covered by the diet. The only exception is for those children being fed exclusively with powdered or artificial milk not fortified with copper. They can become anaemic

7.4- Magnesium (*Source: «Food and Human Nutrition» DUPIN/CUQ)*

Role: There are numerous biological roles, such as assisting with the synthesis of nucleic acid, absorption of lipids, presence in glucose. The adult human body contains about 25g of magnesium. Within a normal diet, 30% to 40% of the magnesium present in the food is actually absorbed. Vitamin D assists in this absorption.

It is advised to take no less than 350mg per adult. Intakes are often less than this figure, especially for women.

Natural Sources: Foods rich in Magnesium include cocoa, dried fruits, non refined cereals. Bread is a poor source of magnesium.

Recommended Nutrients Intakes:

Recommended nutrient intakes for magnesium (Mg) in milligrams (mg)

Age group	Assumed body weight Kg	RNI mg/day
Infants and children		
0–6 months		
Human-milk fed	6	26
Formula fed	6	36
7–12 months	9	54
1–3 years	12	60
4–6 years	19	76
7–9 years	25	100
Adolescents, 10–18 years		
Females	49	220
Males	51	230
Adults 19-65 years		
Females	55	220
Males	65	260
+ 65 years		
Females	54	190
Males	64	224

Source: Report of a joint FAO/WHO expert consultation on human vitamin and mineral requirements

Deficiency: A deficiency in magnesium is sometimes observed in people suffering from prolonged or severe diarrhoea. Malformations may occur in certain people being treated diuretically over a long period of time.

7.5- Iodine

Role: used for the synthesis of the thyroid hormones, vital for growth and cell differentiation.

Natural Sources: Source: («Food and Human Nutrition» DUPIN/CUQ)

Above all this is seafood, which is naturally rich in Iodine.

Recommended Nutrients Intakes:

Proposed revision for daily iodine intake recommendations of 1996 by the World Health Organization, United Nations Children's Fund, and International Council for the Control of Iodine Deficiency Disorders

Population sub-groups	Total iodine intake µg/day	Iodine µg/kg/day
Infants (first 12 months)	90*	15.0
Children (1–6 years)	90	6.0
Schoolchildren (7–12 years)	120	4.0
Adults (12+ years)	150	2.0
Pregnant and lactating women	200	3.5

* Revised to 90 µg from the earlier recommendation of 50 µg.
Source: Report of a *joint FAO/WHO expert consultation on human vitamin and mineral requirements*

Iodine Deficiency: (Source: Treating Child Nutrition. C.Ricour; J. Ghisolfi; G.Putet; O. Goulet.)

When the physiological needs of iodine are not covered in the majority of the population, there develops a series of anomalies understood to change the function of the thyroid gland. In severe cases of deficiency, endemic goitre and cretinism appears, as does the reduction in birth rates and an increase in the infant and peri-natal mortality.

Prevention of this problem can be easily realised by iodine fortification of food products such as table salt.

There remain large geographical regions in the world where iodine requirements are not covered and are effected by the subsequent deficiencies. This is more likely to affect mountainous areas of the world, such as the Himalayas and the Andes. Nevertheless, it is equally possible to see cases of goitre from this deficiency within areas situated at sea level, as for example, central Africa.

Problems relating to iodine deficiency:
- Foetus: Abortion, increase in peri-natal mortality, retardation of cerebral development, endemic neurological and cretinism (myedemateux).
- New-born: Low birth weight, goitre and a under active thyroid gland.
- Infants and adolescents: Increase in infant mortality, goitre, congenital or developed under active thyroid gland, physical and mental retardation.
- Adult: Goitre and its complications, underactive thyroid gland, mental retardation, overactive thyroid gland.

7.6- Iron *Source: («Food and Human Nutrition» DUPIN/CUQ)*

Role: Important in the formation of haemoglobin (exchange of oxygen and carbonic gases with the exterior) as well as myoglobulin in the muscle.
To understand the intakes of iron from food, we should refer at this time to the content of iron in different foodstuffs as well as the percentage of absorption and levels of 'availability'.

Natural Sources: (expressed in mg for 100 grams)
Fruits: 0.1 – 0.3 Dried Vegetables: 6 Calf Meat: 1.2 – 1.6

Potatoes: 0.7	Lentils: 7	Pork Meat: 1
Green Veg: 0.7 – 2	Chocolate: 2	Poultry: 1
Beans: 4	Breast Milk: 0.07	Cow or calf Liver: 8
Rice: 0.4	Cow's Milk: 0.03	Fish: 0.3 –1
White Bread: 0.4 – 0.8	Cow's Meat: 2.5	Oysters: 6

Percentage of Absorption:
Haem Iron (in haemoglobin and myoglobin) present predominantly in foods of animal origin is much better absorbed (bioavailability in the order of 25%) than non haem iron (transferrin, stored forms: ferritine..) (bioavailability from 1-5%).

Available Iron:
It is possible to say that in western style foods, the bio-availability of iron is between 10% and 15%. Considering the under-developed countries where foods of animal origin are consumed to a lesser degree, the availability of iron is closer to 5%.

Recommended Nutrients Intakes:

Iron intakes required for total absolute iron requirements 95th *

Age group (years)	**Median mg/day**	**Pertcentil mg/day**
Children		
0-5	0.72	0.93
1-3	0.46	0.58
4-6	0.50	0.63
7-10	0.71	0.89
Males		
11-14	1.17	1.46
15-17	1.50	1.88
18+	1.05	1.37
Females		
11-14**	1.20	1.40
11-14	1.68	3.27
15-17	1.62	3.10
18+	1.46	2.94
Post-menopausale	0.87	1.13
Lactating	1.15	1.50

* Total Absolute Requirements = Requirement for growth + basal losses + menstrual losses (females only)
** Non-menstruating.
Source: Report of a *joint FAO/WHO expert consultation on human vitamin and mineral requirements*

Iron Deficiency :(Source: Treating Child Nutrition. C.Ricour; J. Ghisolfi; G.Putet; O. Goulet.)
The deficiency of iron results from firstly, insufficient individual intake of iron and secondly, the needs created by the synthesis of different molecules containing the metal. The organism responds by using the stored iron as well as increasing the intestinal absorption rate of the metal. When the reserves are exhausted, the deficiency induces disturbances of the blood production resulting in anaemia.

Signs of deficiency are the following:
Reduced physical ability, reduced intellectual capacity, less resistance to infection as well as disruption in the digestion process.

The Treatment of Iron Deficiency: *(Source: Treating Child Nutrition. C.Ricour; J. Ghisolfi; G.Putet; O. Goulet.)*

Preventative Treatment:

The correct iron balance within a child is needed from the outset in order to have firm starting point, this level of sufficient iron intake should be found while in the mother's womb. It is advisable to check the health condition of pregnant women in order to treat those who suffer from deficiencies. This would then be a systematic supplement, especially if they have already had children.

Curative Treatment:

A deficiency should be treated by an oral intake of ferrous salt. A dose of 3mg/kg/day is sufficient, but should be administered in a prolonged manner (3 to 5 months). There exist different preparations: Fumerate Ferrous=FUMAFER, the federate of sodium=FERROSTRANNE, the heptogluconate ferrous=HELIOFER. Certain forms are coupled to Ascorbic Acid=ASCOFER. A strong treatment results with black faeces and may create digestive troubles, such as vomitting, constipation, and diarrhoea, which have a tendancy to disipate as the dosage is reduced.

*7.7- **Potassium*** *(«Food and Human Nutrition» DUPIN/CUQ)*

Potassium finds itself concentrated in the interior of the cells. All animal or vegetable tissues are richer in potassium than in sodium. The needs in potassium are always practically completely covered.

Daily Needs: The average intake within a normal ration is evaluated at around 2-4g per day.

Deficiency: Potassium deficiency can induce an increase in the digestive losses of those suffering from severe and elongated diarrhoea, a reduction in the re-absorption of potassium by the kidney as well as prolonging the work of certain diuretics.
In developing countries, potassium deficiencies are one the main causes of diarrhoea.
In case of insufficient intake originating from a diet composed primarily of cereals, which have low levels of potassium, there exists a risk of severe hypokaliemie increasing the death rate associated with diarrhoea.

Natural Sources : Foods rich in potassium: powdered coffee, freshly ground coffee, yeast, soya flour, dry apricot, milk powder, raw white beans, dried bananas, potato chips.

7.8- Other Trace Elements

Fluorine, phosphorus, nickel, cobalt, selenium, manganese... although certain elements are present only in very small quantities in the human body, they remain vital. Their principle role is in the production and proper functioning of enzymes.

Information about minerals and trace elements was found in «Food and Human Nutrition» DUPIN/CUQ / MALEWIAK/LEYNAUD-ROUAUD/BERTHIER, in « Treating Child Nutrition » C.Ricour; J. Ghisolfi; G.Putet; O. Goulet.) and in Report of a joint FAO/WHO expert consultation Bangkok, Thailand / WORLD HEALTH ORGANIZATION FOOD SND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS Rome, 2002

SUMMARY

The food intakes vary in quantity and quality. These figures vary, depending on age, health status, type of activity, life conditions and climate but equally from one individual to another. The following average intakes do not take into account all the individual variations.

The proportion of calorific intake should be approximately 10-15% Protein, 30-35% Fats, 50-55% Carbohydrates.

Essential Nutrients

Proteins **Amino Acids**	(+ Histidine for infants) Lysine Leucine, isoleucine, valine Methionine, Phenylalanine, Tryptophane, Threonine	
Lipids **Fatty Acids**	Acide linoleic Acide linolenic	
Vitamins	Retinol Calciferol Tocopherol Phylloquinone Thiamin Riboflavin Nocitinamide / Niacin Pyrodoxine Ac. Panthotenic Ac. Ascorbique Ac. Folic / folate Cobalamine Biotine Flavonoide Ac. Lipoique	Vit A Vit D Vit E Vit K Vit B1 Vit B2 Vit PP ou B3 Vit B6 VIT B5 Vit C Vit B9 Vit B12 Vit H
Minerals	Calcium Chlorine Magnesium Sodium Potassium Iron Phosphorus	Ca Cl Mg Na K Fe P

TraceElements	Chromium Copper Fluorine Zinc Iodine Molybdene Selenium	Cr Cu F Zn I Mo Se

II- FOODS

A- FOOD COMPOSITION

Foods are composed of a mixture of proteins, sugars, fats, water, vitamins and minerals.

1- PROTEINS

These are necessary for life and should represent between 10-15% of the daily calorific value. They are composed from a mixture of amino acids some of which are considered 'essential'.

Proteins produce 4 Kcal per gram (17 Kj)

1.1- Vegetables and Vegetable Seeds

Cheap and abundant, vegetable protein is deficient in most essential amino acids, in particular methionine, although it is rich in Lysine. A mixture of cereal and vegetable allows the deficiency in amino acids to be rectified and supplies the proper nutritional value of proteins, as long as the basic calorific protein needs are covered (if not there will be a deterioration in protein energy).

Seeds rich in oil and protein
Certain seeds are rich in proteins and/or rich in fats.

Peanuts contain 50% fat, 27% protein as well as niacin, which assists, even in small quantities, to reduce the prevalence of pellegra in those individuals whose staple food is maize. It is equally rich in folates. Nevertheless peanuts are poor sources of methionine, as well as lysine, leucine and threonine. Conserving peanuts is necessary in order to protect against humidity. They are attacked by Asperigillus flavus mushrooms which secrete an aflotoxine, a factor which precipitates the development of liver cancer.

Soya contains 18% fats, and 35-40% of proteins. Despite a slight deficit in methionine, its contents in lysine complements a diet dominated by cereals. Certain varieties of bitter soya require soaking for dozens of hours to the breakdown of the outerwall. Boiling in water eliminates the antitrypsic factor limiting digestion. Milling of soya grains produces soya milk. Adding magnesium curdles the soya milk and produces tofu.

Other Vegetable Sources: Dried Vegetables:
These contain around 2-6% fats, 20-25% protein, B-Vitamins, and are rich in starch (a form of carbohydrates). They are deficient in methionine and rich in lysine. Certain carbohydrates are poorly digestible, as they contain alpha-galactoside proteins. Beans and peas are less digestible than foods of animal origin, but this is improved after prolonged cooking.

1.2- Animal Products

Meats contain 15-20% of good quality proteins, 2-4mg/100g of iron, which is better absorbed than iron of vegetable origin.

Offal contains 16-20% of proteins and anti-anaemic nutrients, such as iron (10-12 mg/100g), folates and the B12 vitamins. Animal blood is particularly rich in iron (52mg/100g), but is consumed very rapidly.

Fish is an important source of protein, containing around 18-22%. It is rich in unsaturated fatty acids, iodine and iron. Different fish vary in their percentage of fat content; 5% of fat in fish considered as Low fat, 10% in Semi-fat fish (such as sardines), and more than 10% in fish considered as Fatty (such as Tuna).
The bones of fish are rich in calcium and fluorine.

Mussels and Crustaceans, like fish, are rich in protein, iron, iodine, vitamin A and B. There is a risk, however, of contamination by different bacillus or virus.

Eggs represent the best source of protein. Considered by FAO as having a combination of proteins that is equal to the Biological Value of 100. An egg contains 12-14% of protein. The dangers relating to the consumption of eggs are decreasing. As a result, poultry husbandry is favoured, as is the selection of egg laying hens: 'Animal husbandry does not require a lot of space and is therefore effective in urban areas'. Easily digested by those after 6 months of age, the white eggs should be cooked to insure absorption by the intestinal membrane.

In tropical climates, the eggs should be eaten within the first 5 days in order to avoid any problems of chemical transformation or mould growth within the egg itself, as well as to ensure there is no contamination from the shell (salmonella poisoning starts in the shell). Holding the egg up to the sun, the dark yellow mass should be in the middle. If it is near the side then the egg is not fresh.

Another procedure to extend the life of the egg involves keeping the egg in salted water (salt should constitute 12%). For the first 2-3 days, the yolk should be centred within the liquid. After the fourth day, the yoke moves towards the surface, and then after 15 days, the egg will lay horizontally on the surface of the water.

Milk and it's Derivatives
Milk constitutes the only food for infants. It is important to promote breastfeeding in developing countries, due to the numerous advantages that are connected with breastfeeding (see Annex 3 on Promotion of Breastfeeding).
It contains 87% water, 3.5% proteins of high biological value as well as a balanced proportion of essential amino acids. The essential protein is casein, which has specific properties that permit certain bio-chemical transformations.
Camel and goat milk are richer in protein (2%) than cow's milk.
Carbohydrates are primarily in the form of lactose (approx.5%). Lactic bacillus transforms, by fermentation, lactose into lactic acid, which is more commonly found in yoghurt than in milk, and is more easily conserved in this new form. It can also be transformed into fermented milk, but this type is alcoholic.
The portion of fats in cow's milk depends upon the species and the diet of the cow, and thus the fat content ranges between 3-5%. Animal milk is very rich in calcium, which is assisted by lactose for its intestinal absorption.
Rich in retinol, riboflavin, and thiamin, the energetic value of milk depends on its fat content. For example, a 4% fat content will give 700 kcal per litre of milk.

The volume of milk produced is influenced by the food consumption of the animal. In Africa, the normal level of production is considered to be between 1-2 litres, whereas in Europe, this can be as much as 30 litres.
The quantity of milk production depends greatly on the food consumption of the lactating woman. For a 'well fed' woman, the quoted volume of milk production is 800 ml for a period of lactation, whereas for poorly nourished women, the volume can be as low as 300ml. Conversely, the composition of breast milk hardly varies when the mother is suffering from micro-nutrient deficiencies.
Milk hygiene is important, as milk bacteria can transmit Bovine tuberculosis and goat brucellosis. Hygiene measures that can be taken include cleaning the hands and containers, boiling the milk for 5 minutes, and consuming the milk in the following hours.

2- LIPIDS

This improves the energetic density of the food. They supply the essential fatty acids (predominantly in vegetable oils) and facilitate the absorption of fat soluble vitamins (Vitamin A, E). They improve the fluidity of a dish as well improve the taste.

Fats produce 9 Kcal per gram

2.1- Fats of vegetable and animal origin

Essential Fatty Acids (saturated / unsaturated): It is possible to regard animal fats as 'saturated' and those of vegetable origin as 'unsaturated'. Unsaturated essential fatty acids include linoleic, linolenic, and arachidonic acids.

Average Composition of Body Fat

	SATURATED	UNSATURATED
	Cream and Butter	**Other Fatty Materials**
Water	-Cream: variable according to the creaming procedure. -Butter: Maximum allowance 16%	-Oil: Vegetable, Lard: Practically None. -Margarine: 16%
Sugars	-Cream: Approx 3% -Butter: Traces of lactose in the butter and impurities present cause the proliferation of bacterial formation, resulting in rancidity.	-Oils and Fats: None -Margarine: should obligatory hold 2% starch which is added to differentiate between butter.(turns blue on contact with iodised water).
Fats	-Cream: 35% on average -Butter: between 82% and 84% -Fats in butter are, above all, triglycerols. 1/3 oleic, this explains the low level of fusion in butter. -Butter holds 4% butyrine: when butter is rancid, it transforms into butyric acid through hydrolysis (a somewhat disagreeable odour) -Butter also contains a small level of lecithine and cholesterol.	-Oils, lard, vegetable: 100% -Margarine: 83% -Body fats are a mixture of many triacylglycerols. -Oils contain a large proportion of fats which are unsaturated fatty acids, above all oleic acid. The content of polyunsaturated acids is variable. This is why they are liquid at normal temperatures.
Proteins	-Cream: Approx. 2% -Butter: Traces of casein	None
Minerals and Vitamins	Practically None. Rich in vitamin A (Butter is the food the most rich after liver). Cream and butter are able to contain a small amount of Vitamin D.	Practically None.. No vitamins A. But carotene in palm oil. -Vitamin E in certain Oils. -Essential fatty acids in certain Oils.
Energy	For 100 g: -Cream: 337kcal = 1400kj -Butter: 760kcal = 3177 kj	For 100 g: -Oil, lard: 900 kcal = 3672 kj -Margarine: 760 kcal = 3176 kj

Coconut Oil: Rich in saturated fatty acids.
Palm Oil: Extracted almond oil is contained in the stone of the fruit. Looks similar to coconut oil.
Non-refined palm Oil: Solid oil containing a large proportion of saturated fatty acids. It is extracted from the pulp of the fruit from palm oil. It is rich in Vitamin A. One dessert spoon of palm oil before the age of one is sufficient.

Refined Palm Oil: moving away from crude palm oil. The refining process eliminates some of the more undesirable elements (necessary to remove before consumption), some of which are responsible for the specific taste and smell of the cruder oils. The refining process is also used to sustain and improve the organoleptic characters (freshness, flavour and colour) and the stability of the fat.
Peanut oil: Rich in saturated fatty acids. Remains stable when heated.
Soya Oil: Rich in unsaturated essential fatty acids and linolenic acid. Fragile when heated.
Cod Liver Oil: very rich in Vitamin A and D.
Lard: (Pork Fat) as much saturated fatty acids as unsaturated.
Suet: Richest in saturated fatty acids.

2.2- Butters and Margarine's

These are made from animal and vegetable products.
Butter: Rich in fat soluble Vitamin A and D.
Margarines: Fats in the form of an water emulsion in the oil.

2.3- Oil producing seeds and fruits

These have a dual role, containing both fats (between 30-65%) as well as proteins (12-35%). Examples are oils from seeds of watermelon, sesame and sunflowers. They are rich in Vitamin B, iron, calcium, and carotene.

3- CARBOHYDRATES

These foods constitute the main source of nutritional energy in the developing nations. The source is above all through the consumption of cereals and tubers. These foods rich in energy should normally be cooked in water, especially before giving to children. The water is absorbed by the starch and considerably diminishes the energetic density of the cooked foods.

Sugars produce 4 Kcal per gram (17 Kj)

3.1- Cereals

Although the supply of energy is good from these particular foods, the composition of amino acids from cereals results in a deficiency in at least one essential amino acid: lysine.

All the cereals are of comparable structure, the grain consists of:
- **external casing** without nutritional value: cellulose layer, pericarp, tegument. Many indigestible elements exist, however, the intake of fibre is useful to increase the weight of foods in the bowel and hence improve intestinal movement;
- **Aleurone**, rich in proteins, vitamins (niacin and riboflavin) as well as minerals;
- **The germ or embryon,** very rich in thiamin, riboflavin and niacin;
- **Endosperm,** the most important part of the grain where the majority of the starch is contained.

Rice:
Rice, when still encased is called 'paddy rice'. Without this casing, having been stripped by a milling process (e.g. Pestle and mortar or grindstones), the rice is called wholegrain or unrefined. Regarding the high consumers of white rice, that is white or semi-white: The

milling may remove the germ and more of the outside layers from the wholegrain. If the cereal is rice, this is called polished rice. Other cereals are usually milled into 'white' or refined flour. As a result Beri-beri can occur from thiamin deficiency. Traditional preparation of rice contains sufficient quantities of thiamin to cover the needs of the population.
An Indian process exists called steaming. From paddy rice this is soaked and then steamed for 10-20 minutes allowing the water to be absorbed by the grain and in this way the B Vitamins remain in the endosperm. Drying and then milling allows the polishing and bleaching of the rice without the loss of important vitamins (75% of the thiamin and 100% of the riboflavin). The risk remains that while cooking the vitamins while pass into the boiling water.
The water from this process can be used in the treatment of frequent cases of diarrhoea.

Maize:
This contains 10% protein, is poor in lysine as well as tryptophane and niacin. The lack of tryptophane (A.A.E) and of niacin (Vitamin PP) can cause pellagra. To correct these deficits, a combination of foods, maize plus vegetables or maize boiled in water at around 80 degrees C permits the release of digestible niacin. Young maize contains pro-vitamins. Industrial processing of maize results in the loss of thiamin of up to 85%, 23% of riboflavin and 30% of niacin. But certain countries have legislation that make provision for the fortification of flour.

Millet and Sorghum:
This is a staple food within dry regions, it contains two thirds carbohydrates, 7-17% proteins. It is deficient in lysine, though they are a good source of thiamin (Vit.B1) and niacin (Vit.PP) Poor in calcium, their content in iron is substantial.
Preparation: crushed by mortar, then crushed again, peeled by milling. Then cleaned and dried in the sun for 20 minutes. Sifting allows the separation of the coarse and finer flour. The fine flour is then the base for couscous. The coarse flour, made up of the central part of the grain, less rich in vitamins and proteins, is used for millet gruel or porridge. The millet can be completely ground down into a form of fine flour used to prepare dough: 'To' from Mali and Burkino Faso.

Fonio is eaten in West Africa and is relatively poor in proteins: 6-7%, but it can secure the difficult periods between harvests.
Teff or Ethiopian millet consumed in Ethiopia contains a substantial quantity of iron.
Eleusine from very small seeds, is similar to Fonio. Eaten in Asia and Africa (Ethiopia and dry regions), adapted to poor soils or where other cereals would not grow.

Wheat:
Primarily grown in the developed countries, it has seen an increase in consumption in the developing nations in the form of bread, especially in the urban areas. Like the other cereals it's nutritional value depends on the level of extraction. The greater the extraction level the whiter the flour will be, as will be the reduction in the level of phytic acid. Example: 75% extraction will result in the 25% of the weight of the grain being lost. This white flour will have lost a large quantity of B Vitamins.
The entire content of the flour in terms of proteins is 11-13%, 75% of carbohydrates. If the level of extraction is reduced from 85% to 70% then the protein content will be reduced to 6%.

Oats:
This is richer in proteins than rice, wheat and maize, but contains phytic acid which limits the absorption of iron.

Buckwheat:
This is poor in proteins as well as minerals.

Barley:
This is consumed in certain parts of Africa (Morocco) in the form of couscous. Its nutritional value is similar to that of wheat.

Quinoa:
This is cultivated in South Africa and contains 12-16% protein.

Rye:
This is consumed in the CIS (Ex-Soviet Union) in the form of bread.

3.2- Roots and Tubers

These are poor in proteins, minerals and vitamins. Cultivation and conservation in the ground is considered easy and explains the importance given to them by some cultures. In addition to the consumption of the roots, the utilisation of the leaves of these plants also have some important nutritional advantages, containing 7% protein, as well as some vitamins and minerals.

Yam
This contains between 2-8% proteins. Eaten boiled or roasted, the wild varieties often contain sharp and toxic elements that can be eliminated after boiling. It should be stocked in a dry environment and not in the ground.

Taro and Macabo:
Their leaves are often compared to the ears of an elephant. They are poor in proteins (1.5% - 2%). They supply flourine. Eaten roasted, boiled, sliced, pureed or even fermented.

Sweet Potato:
This has a high content of carotene.

Manioc / Cassava:
This is conserved well in the soil, meaning it can be harvested on a day to day basis. But this cultivation is too often repeated, slowly reducing the quality of the soil. The Proteins (1-1.5%) are of weak biological value (deficient in methionin). Exclusive consumption can result in certain nutritional problems. There are two varieties: The sweet variety, that can be consumed after peeling and boiling and the bitter variety, whose tubers contain toxic substances which is found mainly in the skin of the tuber itself.
For the bitter manioc, an initial step should be taken: the manioc should be placed in water for a number of days, after having peeled the skin rich in toxins, this produces a fermentation process that dissolves any remaining toxins.
Preparation: Manioc bread, boiled (foufou), tapioca.
Manioc or cassava, consumed in numerous countries, R.D.C (ex-Zaire), Cameroon, Benin..) contains a factor leading to goitre (thiocyanate), which can explain the existence of goitre and severe hyperthyroid problems in these regions.

The Other Tubers:
The potato, fruit bread (oceania), peasant fruit, sagou, (pacific islands).

3.3- Sugar Products

Sugar:
This is 100% saccharine, a rapidly absorbed carbohydrate. On the other hand starch is absorbed very slowly.

Honey:
This has a laxative effect.

4- VITAMINS AND MINERALS

Fruits and Vegetables.
In terms of energy supply, for fruits and vegetables, this is negligible (40kcal for 100g). Rapid urbanisation within developing countries has resulted in those who used to live in the rural areas where they were used to picking and cultivating vegetables are not willing to spend money on these foods. This explains the deficiencies observed in these populations.
Fruits and vegetables contain an important quantity of water (80-95%).

4.1- Vegetables

Amongst the minerals contained in vegetables, we must mention calcium, the iron is contained in the dark green leaves (leaves of manioc, amaranthe and green beans) and a significant level of proteins (8%).
Fresh vegetables lose part of their vitamin content during transportation, also during the cooking process, especially when boiled in water. When certain vegetables are dried the ascorbic acid is destroyed.

4.2- Fruits

These contain practically no fats whatsoever and are also very low in energetic value (around 55kcal for 100g). The protein content is negligible but the supply of fibre as is the case with vegetables is important. The essential component in fruit is Vitamin C and for orangy yellow fruits this also includes pro-vitamin A.

The banana.
More uniquely, this contains starch and is also rich in carotene, vitamin C and potassium.

5- ANTI-NUTRITIONAL FACTORS, CONTAMINANTS

Certain foods contain certain contaminants that influence the incidence of various types of cancers. The most common contaminants are produced from a mixture of plant synthesis processes or supplied by contamination. They are found mainly in vegetables. Their concentration is often weak and they are generally destroyed by heat treatment or extracted into the water during boiling. It should not be forgotten however that vegetables constitute an important source of energy, mineral and above all, protein.

5.1- Contaminants

*Mycotoxins
Microscopic mushrooms grow in food producing toxins harmful to humans.
Aflotoxins (Aspergillus Flavus) is the best known and is found in particular in peanut seeds, but also in cereals and vegetables. This can result in cancer of the kidney. Medical treatment in many cases can destroy this type of cancer, however, attention should be paid to foods prepared in a traditional manner for local consumption.

*Nitrogen Fertilisers
If overly used, the nitrosamines are carcinogenic.

*Certain Non Natural Hormonal Derivatives
Distilbene, well known for its therapeutic properties (1946-1976) in young women with the threat of spontaneous abortion. The consequences of which were alterations in the vaginal mucous membrane producing cancer of the vagina.

*Certain Food Additives
Such as nitrites, artificial sweetners, and certain colourants.

5.2- Anti-Nutritional Factors

*Protease Inhibitor: deficient in methionin.

*Hemoglutinines or Lectines
These cluster around the red blood cells and provoke growth retardation, colitis and anemia if they are consumed regularly.

*Glucosinates
They can cause disturbances in the thyroxine synthesis and hence the metabolism of iodine.

*Phytic Acid
Inhibits the absorption of Zinc, Iron, Calcium and Magnesium.

*Antivitamins
It blocks the action of specific vitamins at their site of action (e.g. E within beans....).

B- FOOD RATIONS

1- CALCULATION OF FOOD RATION

All the currently consumed foods were recorded in tables that present their composition and nutritional elements for 100 g. These are the National Food Composition Tables; hence it is necessary to mention the references used for dietetic calculations.
The values are given by 100g of crude weight.
These tables assist with rapid calculation of food rations giving their composition in proteins, fats, carbohydrates, vitamins and minerals as well as their energetic value.
NUTCALC software performs the same function, although computerised.

1.1- In practice: calculating a food ration

Let's take an example: you want to calculate the calories entailed in a meal composed of 125g of potatoes, 20g of oil and 65g of liver.

1st Step: in the Food Composition Table, look for the energy value and the proportion of proteins, lipids and carbohydrates of the ingredients of the meal. The proportions are given for 100g.

Table 1: Composition of the ingredients

Foodstuff	Quantity (in g)	Proteins (in g)	Lipids (in g)	Carbohydrates (in g)	Kcal
Potatoes	100	1.7	0.1	18.9	82
Oil	100		100		900
Liver	100	20.0	4.0	5.0	136

2nd Step: adapt the values in the table to the quantities used in the meal. You can create a new table to do this (table 2).
You need 125g of potatoes.

- 100g of potatoes contain 1.7g of proteins, so 125g contain:
  1.7x 125/100= 2.125g of proteins
- 100g of potatoes contain 0.1 g of lipids, so 125g contain:
  0.1x 125/100= 0.125g of lipids
  And so on for Kcal, and carbohydrates

Table 2 Summary of the values according to the quantities used in the meal

Foodstuff	Quantity (in g)	Proteins (in g)	Lipids (in g)	Carbohydrates (in g)	Kcal
Potatoes	125	2.125	0.125	23.625	102.5
Oil	20		20		180
Liver	65	13.0	2.6	3.25	88.4

3rd Step: Calculate the total energy value and the proportions of lipids, proteins and carbohydrates of your ration.
Add these totals to the table:

Foodstuff	Quantity (in g)	Proteins (in g)	Lipids (in g)	Carbohydrates (in g)	Kcal
Potatoes	125	2.125	0.125	23.625	102.5
Oil	20		20		180
Liver	65	13.0	2.6	3.25	88.4
TOTAL	**210**	**15.125**[7]	**22.725**	**26.875**	

You will then need to convert the values of proteins, lipids and carbohydrates taking into account the fact that 1g of proteins doesn't have the same energy value than 1 g of lipids or carbohydrates.
1g of proteins = 4 Kcal 1g of lipids = 9 Kcal 1g of carbohydrates = 4 Kcal
Add these values to your table:

Foodstuff	Quantity (in g)	Proteins (in g)	Lipids (in g)	Carbohydrates (in g)	Kcal
Potatoes	125	2.125	0.125	23.625	102.5
Oil	20		20		180
Liver	65	13.0	2.6	3.25	88.4
TOTAL	**210**	**15.125**	**22.725**	**26.875**	
in Kcal		**15.1x4 = 60.4**	**22.7x9 = 204.3**	**26.9x4 = 107.6**	**372.3**

You can now calculate the proportions of the total energy value contained in the proteins, lipids and carbohydrates : the total energy value of the meal is 372.3 Kcal (=100% of the energy value) ; this means that the 60.4 Kcal contained in the proteins represent 16.2% of the total energy value, that is :

60.4x 100/372.3 = 16.2

The 204.3 Kcal contained in the lipids represent 54.9 % of the total energy value, that is :

204.3x 100/372.3 = 54.9

The 107.6 Kcal contained in the carbohydrates represent 28.9% of the total energy value, that is:

107.6x 100/372.3 = 28.9

Foodstuff	Quantity (in g)	Proteins (in g)	Lipids (in g)	Carbohydrates (in g)	Kcal
Potatoes	125	2.125	0.125	23.625	102.5
Oil	20		20		180
Liver	65	13.0	2.6	3.25	88.4
TOTAL	**210**	**15.125**	**22.725**	**26.875**	
in Kcal		**15.1x4 = 60.4**	**22.7x9 = 204.3**	**26.9x4 = 107.6**	**372.3**
in %		**16.2**	**54.9**	**28.9**	**100**

4th Step: looking at the results obtained, you can now tell whether the food ration is well balanced or not, compared to the recommendations.
This meal does not answer the requirements: the proportion of lipids is too high (54.9%) and not enough carbohydrates (28.9%)

You now want a food ration that contains 500kcal of which 13% of proteins, 35% of lipids and 52% of carbohydrates, and which is composed of CSB, Oil and sugar.

[7] It is recommended to round the figures : 15.125 will become 15.1 and 26.875 will become 26.9.

1st Step: you start with the Food Composition Table.

Table 1 Food Composition for 100g

Foodstuff	Quantity (in g)	Proteins (in g)	Lipids (in g)	Carbohydrates (in g)	Kcal
CSB	100	18.0	6.0	60.0	366
Oil	100		100		900
Sugar	100			100	400

2nd Step: you calculate what proportion to the total 500 Kcal should come from the proteins (in this case 13%, that is 65 Kcal), from the lipids (35%, that is 175 Kcal) and by the sugar (52%, that is 260).
You will then need to convert these values into « grams » of proteins (in this case 65/4 = 16.25g), of lipids (in this case 175/9 = 19.4g) and carbohydrates (in this case 260/4 = 65g)

3rd Step: you look for the source of proteins in your foodstuffs. It is recommended to start with the proteins: if needed, you can always add some sugar or some oil to balance the ration.
You then apply the Rule of three to find out what quantity of each food you need to get the exact amount of proteins that you want.
You can now find out how much lipids and carbohydrates this foodstuff contains.

4th Step: add some oil and sugar to make up for the missing quantities of lipids and carbohydrates and your ration is ready.

Foodstuff	Quantity (in g)	Proteins (in g)	Lipids (in g)	Carbohydrates (in g)	Kcal
in %		13	35	52	100
in Kcal		65	175	260	500
TOTAL		16.25	19.4	65	
CSB	90	16.2	5.4	54.0	
Oil	14		14.0		
Sugar	11			11.0	

You will find a series of exercises in the appendix.

2- BALANCED FOOD RATIONS

Nutritional recommendations are expressed in recommended intakes in terms of energy and the desirable levels of macronutrients (protein, carbohydrate and fats) as well as micronutrients.
The way in which one is fed often depends less on nutritional ideas but on socio-economic, cultural, psychological (habits and taboos), economics and seasonal factors.
Firstly, one of the principle components of a balanced diet is to adopt a varied diet, it is suggested to diversify the core foods within the same group.
A balanced food ration is managed over numerous days (a week, even more). A separation of the foods at hand during a single day is an additional factor that can be taken into account to ensure a balanced diet.

2.1- Energy.
The average energetic requirements of a group should be reached.

2.2- The Nutrients
The recommended quantities should cover the needs of practically all the individuals in a popluation, the allocated quantities being greater than that of the average requirements.

The quantities indicated refer to the level of energy and nutrients after absorption from a usual mix of foods consumed during a meal.

During a dietetic evaluation, no nutritional recommendations should be considered separately. A need for a particular nutrient depends on the level of presence of other nutrients (e.g. Vitamin A/ Fats)
Example: Proteins can not be used effectively without a sufficient quantity of energy within the absorbed food.
Vitamin A can not be used until there is a sufficient quantity of proteins to facilitate its transportation.

The tables of recommended intakes are guides or references to apply to groups, although they should be adjusted when looking at the needs of individuals, such as a child or its mother.

NOTE
Food rations vary in quantity and quality. These figures vary depending on age, health status, the type of activity, life conditions, climate, but equally from individual to individual. It should be understood that the presented figures do not take into consideration all the plausible variations seen in individuals.

Calories originating from various macronutrients should be approximately:
10-15% Protein, 30-35% Fat, 50-55% Carbohydrate.

III- MALNUTRITION

Malnutrition

An abnormal physiological condition caused by deficiencies, excesses or imbalance of energy and nutrients.

A- MICRONUTRIENTS

1- MICRONUTRIENTS CHARACTERISTICS

There are about 40 nutrients that are essential to health.
If any one is deficient then the person will not be healthy and resist disease.
Many are ignored by nutritionists and their deficiency is not recognised.
They are divided into two groups in terms of the response to a deficiency

Type 1	Type 2
Functional nutrients	Growth nutrients
Has a body store	has no body store
Reduces in concentration with deficiency	stable tissue concentration
Specific signs of deficiency	no specific signs of deficiency
Growth failure not a feature	Growth failure the dominant feature
Variable in breast milk	stable in breast milk

2- TYPE 1 AND TYPE 2 MICRONUTRIENTS[8]

Type 1:	Type 2
iron	nitrogen (= azote)
iodine	essential amino acids
copper	potassium
calcium	magnesium
selenium	phosphorus
thiamin	sulphur
riboflavin	zinc
pyridoxine	sodium
niacin	chloride
folate	
cobalamin	
vitamin A, D, E, K	

Source: The response to nutrient deficiency. Type 1 and type 2 responses, 2003

[8] Golden M.H.N (1991). The nature of nutritional deficiencies in relation to growth failure and poverty. Acta. Pediatr. Scand. 374, 95-110

B- THE DIFFERENT TYPES OF MALNUTRITION

1- TYPE I MALNUTRITION

Type I malnutrition is leading to a specific disease linked with a specific micronutrient deficiency: ***micronutrients type I*** (Cf. list above)

Examples of deficiency:

- Scurvy due to a vitamin C deficiency
- Beriberi due to vitamin B1 deficiency
- Night blindness and xerophthalmia linked with vitamin A deficiency
- Severe anaemia due to iron deficiency
- Goitre due to iodine deficiency
- Pellagra due to niacin deficiency (vit PP)
- Rickets due to vit D deficiency
- …etc.

2- TYPE II MALNUTRITION

Deficiency of any one of ***type II micronutrients*** (Cf. list above) leads to the same response:

- Tissue repair and growth ceases
- No convalescence from illness
- Negative balance for all type II nutrients
- Anorexia (if diet is unbalanced in type II)
- Growth rate is the dominant determinant of requirement

Type II malnutrition is:

- Acute malnutrition
- Chronic malnutrition
- Underweight

2.1- Acute malnutrition / Wasting

Acute Malnutrition is classified according to the degree of wasting and the presence of oedema.
Acute malnutrition is recent, due to a conflict, displacement, natural disaster, severe outbreak disease (cholera, measles)…etc.
Acute malnutrition is measured with the weight for height index (WFH) or the Body Mass Index (BMI) for adults.
Acute malnutrition is expressed also by a proxy indicator – Mid Upper Arm Circumference (MUAC) – initially measuring the risk of mortality hence indirectly measuring acute malnutrition.

2.1.1- Severe Acute Malnutrition (SAM)

It is severe acute malnutrition (SAM) [9] if the wasting is severe:

- WFH < 70% NCHS median or < -3 SD

[9] The term "protein-energy malnutrition" is no longer used as it is not thought that protein or energy deficiency, per se, are the usual causes of severe acute malnutrition.

- MUAC< 110 mm and / or
- There is oedema

There are 3 types of SAM:

- Marasmus:
  Symptoms: severe thinness (not visible if the child is not naked as the face is the last part of the body to be affected).
  Other signs: big stomach often due to intestines worms, child irritable.

- Kwashiorkor
  Symptoms: presence of bilateral oedema (on both feet). These watery oedemas can after reach the tibias, the hands and the face.
  Other associated signs (not to consider alone): loss of hairs, hairs «bleached», big stomach due to big liver and gas produced by overpopulation of bacteria in the intestines due to immuno- depression. And overall, the child is apathetic.

- Marasmic-Kawshiorkor:
  Child with the signs of both severe acute malnutrition: severe thinness and bilateral oedema. It is then difficult to know which malnutrition started first but it is often a severe case with high risk of mortality. Emergency.

2.1.2- Moderate Acute Malnutrition (MAM)

Malnutrition is defined as moderate acute malnutrition (MAM) if the wasting is less severe:

- WFH between 70% and 80% NCHS median or $-3 \leq$ WFH < -2 SD
- $110 \leq$ MUAC < 120 mm

Oedematous cases are always classified as severe.

2.2- Chronic malnutrition / Stunting

- Old, due to child disease, micronutrient deficiencies of children and/or often mothers, which delay growth…etc.
- Is characterised by a small height (for a given age).
- Is difficult to evaluate in cases where the child's exact age is not known.
- Is measured with the height for age index (HFA)
- Is expressed in moderate (80 ≤ HFA <90% of the median or –3 ≤ HFA < -2 SD) and severe (<80% of the median or < -3 SD)

2.3- Underweight malnutrition or Undernutrition (measured by growth monitoring curve in most health book)

- Mix of the previous two, does not mean a lot
- Low weight for a given age (due to small size (growth delay) or due to a recent weight loss.
- Is measured with the Weight for Age index (WFA)
- Is expressed in different severity levels but usually in moderate (60 ≤ WFA <90% of the median or –3 ≤ WFA < -2 SD) and severe (<60 % of the median or < -3 SD)

3- MEASUREMENTS OF MALNUTRITION

The nutritional status can be evaluated through anthropometric measurements and the presence of oedema.
The anthropometric measurements are:

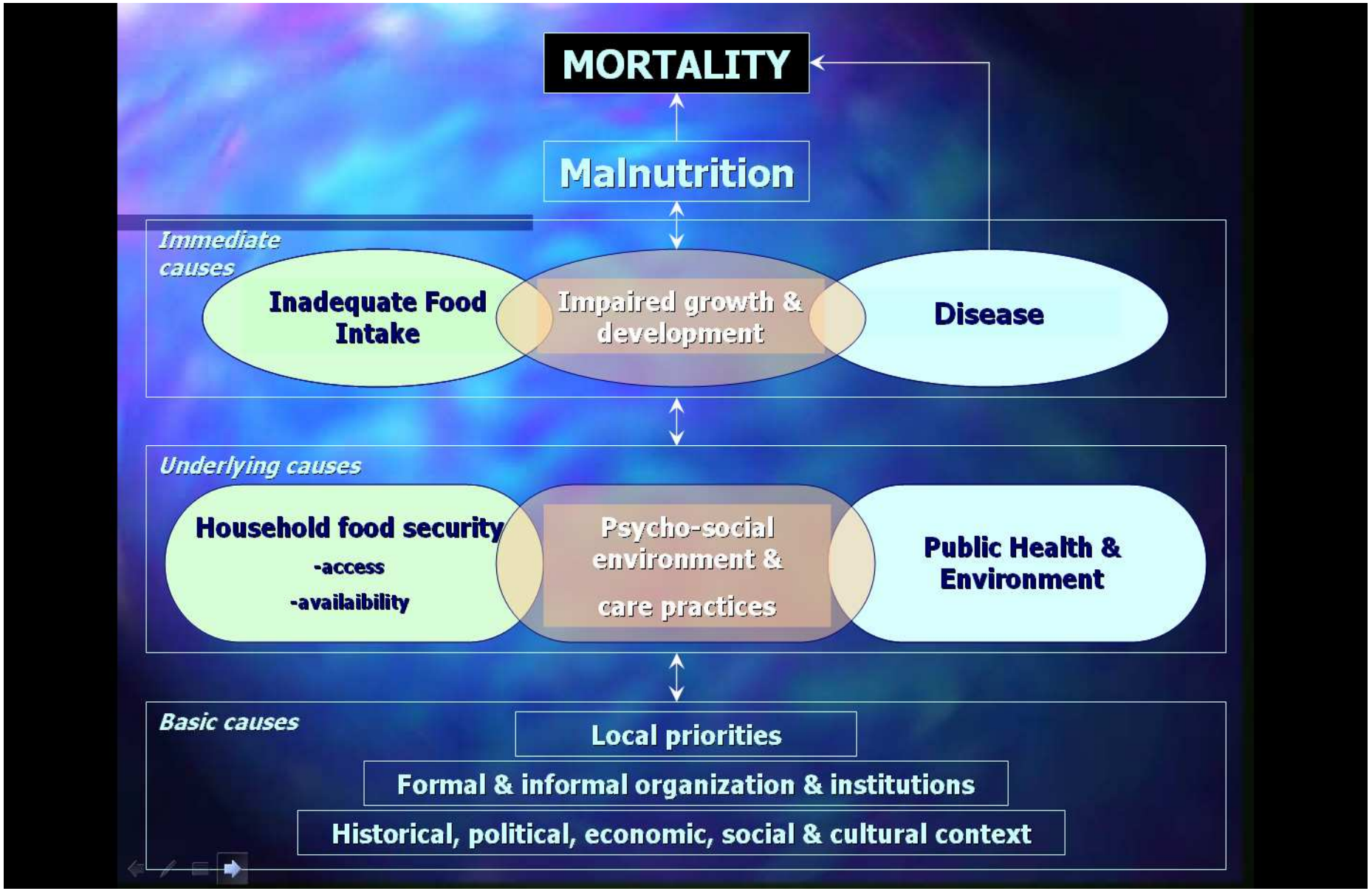
Weight
Height
Mid-upper arm circumference (MUAC)

C- THE CAUSES OF MALNUTRITION:

1- A CONCEPTUAL FRAMEWORK OF THE CAUSES OF MALNUTRITION IN EMERGENCIES

Adapted from UNICEF[10]
This conceptual framework on the causes of malnutrition was developed in 1990 as part of the Unicef nutrition strategy. The framework shows that causes of malnutrition are multisectoral, embracing food, health and caring practices. They are also classified as immediate, underlying, and basic, whereby factors at one level influence other levels (Cf. schema)

[10] this framework was initially conceived in Tanzania by UNICEF in 1990. It was then endorsed and adopted at the International Conference on Nutrition in 1992 at which UN organisations, other agencies and the governments of 159 stated participated. The above version is an adaptation by ACF/AHH/ACH.



2- ANALYSING THE DETERMINING FACTORS OF NUTRITIONAL STATUS

The nutritional status of a population and its determining factors, can be analysed using a causal analysis model (Cf. schema). This model makes a distinction between the causes operating at different levels in the society: individual, household, community, geographic division, country (Young, 1995).
The two immediate factors determining malnutrition are inadequate food intake and infectious diseases. In turn, these are influenced by three underlying causes: food security at household level, sanitary environment combined with access to health services, and social environment. A third level of determining factors, the basic causes, is influenced by potential resources and the economic, political and ideological structure.
For a proper understanding of the nutritional status in a given situation, it is necessary to consider the importance of, and role played by, each of these factors.
Warning about this concept: this concept is theoretical. It allows one to consider the different aspects of an individual's well being. However, the direct causal link between the various factors and malnutrition cannot be shown. This model should be used as a tool with which to view the nutritional situation in context, but not one that attempts to create a direct link between malnutrition and its underlying causes.

2.1- -The underlying causes:

2.1.1- Food security

The ability of a family to produce its food is influenced by many factors: the kind of production (agriculture, horticulture or livestock husbandry), access to fertile land, access to pasture, availability of labour, appropriate seeds and tools, climatic conditions, etc.
The purchase of food is regulated on the one hand by the money coming into the household, and on the other by the availability and price of food in the markets. In emergency situations, whatever the cause, access to food may be affected, forcing the population to modify its normal habits. A family's first reaction to food insecurity is to change its eating habits, either by reducing intake or eating different, cheaper foods, often a lower nutritional value. Population facing regular period of drought and famine tend to find ways of continuing to produce food, but when the future of their food supply is no longer secure, they are often obliged to resort to migration.

2.1.2- Public health – Basic health services and environmental health

Environmental health includes every aspect of the environment that has a bearing on the risk of infectious diseases. The availability of health services and the population's access to these services affects the treatment of disease. Inadequate or delayed treatment exposes the individual to increasing nutritional risks as the illness is prolonged. Access to adequate clean drinking water and the availability of sanitary facilities are important elements in maintaining a healthy environment.

2.1.3- Social environment

The social environment within the household and in the local community directly affects the ability of the family, and its individual members, to look after themselves and to secure an adequate diet. The values inherent in a society have a strong influence on the importance given to the well being of each member of a family. Crisis situations cause serious social

upheaval, in particular the destructuralisation of those social networks, in normal times, would assist the family.

2.2- The basic Causes

The organisation of a society, which includes mechanisms for regulating such things as power, ownership and division of labour, exerts considerable influence over food security, social environment and public health. Social and political changes will affect the population's access to food and basic services.

Sources: ACTION CONTRE LA FAIM: Assessment and Treatment of Malnutrition in Emergency Situations. Manual of Therapeutic Care anf Planning for a Nutritional Programme, 2001, page 58, 59 & 60. Claudine Prudhon

EXERCISES

QCR (Choose the responses you believe are correct)

FOODS

Ques N°1
Rice is:
A- A cereal,
B- A vegetable,
C- A tuber,
D- Other

Ques N°2
Maize is :
A- A cereal,
B- A vegetable,
C- A tuber,
D- Other

Ques N°3
Manioc (cassava) is:
A- A cereal,
B- A vegetable,
C- A tuber,
D- Other

Ques N°4
Soya is:
A- A cereal,
B- A vegetable,
C- A tuber,
D- Other

Ques N°5
The raw tubers are important for their supply of:
A- Energy,
B- Proteins,
C- Fats,
D- Fat soluble Vitamins,
E- Group B Vitamins.

Ques N°6
Most fruits are important in their supply of:
A- Energy,
B- Protein,
C- Fats
D-Vitamin C,
E- Group B Vitamins.

Ques N°7
Vegetable oil is an important source of:
A- Energy,
B- Protein,
C- Fats
D-Vitamin C,
E- Group B Vitamins.

Ques N°8
Which foods are important sources of digestible fibre?
A- Extracted cereals,
B- Green leaves,
C- Body Fats
D- Meats,
E- Partially extracted cereals.

Ques N°9
One gram of fat supplies:
A-2 Kcal
B-4 Kcal
C-7 Kcal
D-9 Kcal
E- None of the Above.

Ques N°10
One gram of carbohydrate supplies:
A-2 Kcal
B-4 Kcal
C-7 Kcal
D-9 Kcal
E- None of the above.

Ques N°11
A-1 Kcalory = 4,18 Kjoules
B-1 Kjoule = 4,18 Kcalories
C-1 Kcalory = 4,18 Joules
D-1 Joule = 4,18 Kcalories

Ques N°12
Regarding proteins in eggs:
A- The quality of proteins in vegetables is sufficient
B- The quality of proteins in soya is sufficient
C- The quality of proteins in meat is sufficient
D- The quality of proteins in fish is sufficient
E- None of the Above.

REQUIREMENTS

Ques N°13
A sufficient level of protein supply according to the sex and category of age as defined by the WHO satisfactory allowance:
A- Protein needs of half the population
B- Protein needs of almost all of the population
C- The protein and energy needs of half the population
D- The protein and energy needs of almost all the population
E- None of the Above.

Ques N°14
A child of 4years consumes a monotonous diet based on cereals and vegetables. From this he consumes 17,5 grams of protein, the safe protein supply for his age. His protein intake is:
A- Satisfactory
B- Unsatisfactory
C- There exists a good chance that the intake is unsatisfactory
D- There is a small chance that the intake is unsatisfactory
E- None of the Above.

Ques N°15
Recommended international levels:
A- An increase in energy intake throughout the pregnancy.
B- An increase in the energy intake during just the last two trimesters of pregnancy.
C- An increase in the energy intake during only the last trimester of pregnancy.
D- A reduction of energy intake during the last trimester of pregnancy.
E- None of the Above.

CALCULATION OF RATIONS

N° 1

You have interviewed the mother of a small boy of 19 months, admitted in a supplementary feeding centre, with regard to the food that she gives the child at the household.
Here is the ration that was received at the household:

1 Bowl of rice flour (about 80 g),
2 spoons of spicy sauce including some cassava leaves and beans (about 20 g),
1 glass of camel milk (150 g),
1 fruit, depending on the season.

Question A :
Calculate the energetic value of the ration.

Composition of food for 100 g :

Foods	Proteins	Fats	Sugars
Rice Flour	6.4 g	0.8 g	83.3 g
Beans (red, raw)	22.1 g	1.4 g	41.3 g
Camel Milk	5.1 g	4.1 g	4.7 g

(Present the results in the form of a table).

Question B :
Do you believe this ration is sufficient? (Explain why?).

Question C:
Do you believe this ration is balanced? (Explain why?)

N° 2

Question A :
Calcualte the daily energetic needs of a 45 year old worker, weighing 70 kg and having an average level of physical activity.
(Explain why?).

Question B :
His daily ration is the following:

- 2 eggs of 60 g,
- 150 g of soft sweet potato,
- 200 g of whole peanuts,
- XXX g of raw brown rice.

Composition of food for 100g:

Foods	Proteins	Fats	Carbohydrates
Eggs (whole, raw)	12.5 g	10.8 g	
Sweet Potato	1.2 g	0.3 g	19.9 g
Brown rice, raw.	6.7 g	2.8 g	76.3 g
Whole Peanuts.	25.6 g	46.1 g	11.7 g

What quantity of brown rice should be consumed to cover the daily energetic needs? To explain your response, please give the the details of your calculations.

Question C :
Calories from sugars should normally represent 50 to 55% of the total ration?
In your opinion, does the ration answer to the requirements, in terms of proportion of carbohydrates in the ration
(Present the results in the form of a table).

N° 3
Develop a ration of 1400 Kcal.

The available foods are:
(Composition for 100 g)

Foods	Proteins	Fats	Carbohydrates
Maize (whole grain)	8.5 g	3.8 g	66.2 g
Beans (green, raw)	24.3 g	1.9 g	45.7 g
Oil		100 g	

(Present the results in the form of a table).

N° 4
Develop a ration of 850 Kcal that will be distributed in a supplementary feeding centre.
The available foods are:
(Composition for 100 g)

Foods	Proteins	Fats	Carbohydrates
Wheat Soya Blend ou WSB	19.0 g	7.0 g	65.3 g
Oil		100 g	
Sugar			100 g

(Present the results in the form of a table).

N° 5
Develop a ration of 1600 Kcal that will be distributed in a supplementary feeding centre.
The available foods are:
(Composition for 100 g)

Foods	Proteins	Fats	Carbohydrates
Corn Soya Blend ou CSB	16.6 g	8.0 g	57.2 g
Oil		100 g	
Sugar			100 g

(Present the results in the form of a table).

N° 6

Develop a ration of 63 Kcal that will be distributed in a supplementary feeding centre.
The available foods are:
(Composition for 100 g)

Foods	Proteins	Fats	Carbohydrates
Mixplus	13.0 g	6.8 g	69.2 g
Biscuit or BP5[11]	14.7 g	17.0 g	60.8 g
Oil		100 g	
Sugar			100 g

(Present the results in the form of a table).

Results of the MCQ and Calculations of Rations

Foods:

1: A	5: A	9: D
2: A	6: D	10: B
3: C	7: A, C	11: A
4: B	8: E	12: C, D

Requirements

13: B	14: D	17: A

Results of the Ration Calculations

The results were calculated on NUTCALC, they take into consideration the following recommendations.

Proteins: 11 - 15% of the total ration,
Fats: 35 - 40 % of the total ration,
Carbohydrates: 50 - 55 % of the total ration,

N° 1

Question A : Calculate the energetic value of the ration.

Foods	Quantity	Kcal	Proteins	Fats	Carbohydrates
Rice Flour	80 g	292.4	5.1 g	0.6 g	66.6 g
Beans	20 g	53.5	4.4 g	0.3 g	8.3 g
Camel Milk	150 g	114.6	7.7 g	6.2 g	7.0 g
Total (g)	250 g		17.2	7.1	81.9
Total (Kcal)		460.5	68.8	63.9	327.6
%		**100**	**14.9**	**13.9**	**71.1**

Question B : Do you believe this ration is sufficient?
No:
A child of 19 months should normally receive a ration of:
1150 Kcal / day (see. Module 1 / 13).

[11] BP5 = 55.5

But he is not receiving more than 460.5 Kcal / day including 13.9 % of fats hence he is missing 689.5 Kcal / day, this ration only covers 40 % of the daily needs.
A ration of 850 Kcal, supplied supplementarily, would complete the deficit of Kcal (460.5 + 850 = 1310.5) but the purpose of giving a supplement in a nutrition centre is not to replace the daily ration but to complete it.

Question C : Do you believe this ration is balanced ? (Explain why?).
No :
When referring to the recommendations, the ration is:

- insufficient in fats,
- excessive in carbohydrates,
- limited in proteins.

The ration can be quickly balanced by adding a source of fats, 15 g of oil for example. But it should above all be recalculated (or eventually doubled) to cover the daily needs of the child.

Ration recalculated with the addition of 15g of oil.

Foods	Quantity	Kcal	Proteins	Fats	Carbohydrates
Rice Flour	80 g	292.4	5.1 g	0.6 g	66.6 g
Beans	20 g	53.5	4.4 g	0.3 g	8.3 g
Camel Milk	150 g	114.6	7.7 g	6.2 g	7.0 g
Oil	15 g	135.0		15.0 g	
Total (g)	250 g		17.2	22.1	81.9
Total (Kcal)		595.3	68.8	198.9	327.6
%		**100**	**11.6**	**33.4**	**55**

N° 2
Question A : Calculate the daily energy needs of a 45 year old worker, weighing 70 kg and having an average level of physical activity.
((11.6 x 70) + 879) x 1.78 = 3010 Kcal / day. (See: Equations Module 1/ tab 3A and 4 P14/15)

Question B : What quantity of brown rice should be consumed to cover the daily energy needs?

Foods	Quantity	Kcal	Proteins	Fats	Carbohydrates
2 Eggs	120 g	177	15.0 g	13 g	
Sweet Potatoes	150 g	131.3	1.8 g	0.5 g	29.9 g
Whole Peanuts	200 g	1128.2	51.2 g	92.2 g	23.4 g
Total 1 (g)	470 g		68.0	105.7	53.3
Total 1 (Kcal)		1436.5	272.0	951.3	213.2

Normally, it should be:

%		**100**	**12.0**	**38.0**	**50.0**
Total (Kcal)		3010	361.2	1143.8	1505
Total (g)			90.3	127.1	376.3

If taking 450g of brown rice as an example.

Total - Total 1 (g)			22.3	21.4	323
Brown Rice	450 g	1607.8	30.2	12.6	343.4

What is required:

Total (g)	920 g		98.2	118.3	396.7
Total (Kcal)		3044.3	392.8	1064.7	1586.8
%		100	12.9	35.0	52.1

Question C : In your opinion, does the ration answer to the requirements, in terms of proportion of carbohydrates in the ration?
Yes : 450 g de brown rice can provide almost exactly the desired ration? Balanced in proteins, fats and carbohydrates.

N° 3 Develop a ration of de 1400 Kcal.

Foods	Quantity	Kcal	Protein	Fats	Carbohydrates
Maize	200 g	666.0	17.0 g	7.6 g	132.4 g
Lentils	100 g	297.1	24.3 g	1.9 g	45.7 g
Oil	50 g	450		50.0 g	
Total (g)	350 g		41.3	59.5	178.1
Total (Kcal)		1413.1	165.2	535.5	712.4
%		**100**	**11.7**	**37.9**	**50.4**

N° 4 Develop a ration of 850 Kcal that will be distributed in a supplementary feeding centre.

Foods	Quantity	Kcal	Protein	Fats	Carbohydrates
WSB	125 g	500.8	23.8 g	8.8 g	81.6 g
Oil	25 g	225	-	25.0 g	-
Sugar	30 g	120	-	-	30.0 g
Total (g)	180 g		23.8	33.8	111.6
Total (Kcal)		845.8	95.2	304.2	446.4
%		**100**	**11.2**	**36.0**	**52.8**

N° 5 Develop a ration of 1600 Kcal that will be distributed in a supplementary feeding centre.

Foods	Quantity	Kcal	Protein	Fats	Carbohydrates
CSB	270 g	991.2	44.8 g	21.6 g	154.4 g
Oil	45 G	405	-	45.0 g	-
Sugar	50 g	200	-	-	50.0
Total (g)	365 g		44.8	66.6	204.4
Total (Kcal)		1596.2	179.2	599.4	817.6
%		**100**	**11.2**	**37.6**	**51.2**

N° 6 Develop a ration of 630 Kcal that will be distributed in a supplementary feeding centre.

Foods	Quantity	Kcal	Protein	Fats	Carbohydrates
Mixplus	70 g	273.2	9.1 g	4.8 g	48.4 g
Oil	10 g	90		10.0 g	
Sugar	5 g	20			5.0 g
BP5 (1 biscuit)	55 g	250.3	8.2 g	9.4 g	33.7 g
Total (g)	140 g		17.3	24.2	87.9
Total (Kcal)		635.4	69.2	217.8	348.4
%		**100**	**10.9**	**34.3**	**54.8**