Nutrition assessment

Each infant is unique. The growth pattern of every infant is individual. Physical growth is a complex process that can be influenced, apart from dietary intake, by environmental and genetic factors, size and gestational age at birth, and medical conditions. Growth rate in infancy is a continuation of the intrauterine growth curve, and is rapidly decelerating up to 3 years of age. In infants and children physical growth is monitored through anthropometry.

Further evaluation is suggested for infants and children with an abnormal growth rate, or recent weight loss.

Complete Nutrition assessment is based on:

- Information that may include history of chronic or acute illnesses or medical conditions, birth history, developmental disabilities, or a clinical assessment identifying signs of nutritional deficiencies.

- Dietary intake data:
  - Diet history: Breastfed and/or infant formula-fed; frequency and duration of breastfeeding; frequency and amount of infant formula or complementary foods fed; age at introduction of complementary foods; variety of complementary foods provided; vitamin/mineral or other supplements given.
  - Food intake: Quantitative and qualitative assessment of food intake. Quantitative assessment techniques include the comparison of individual nutrition intake data to. Assessing this dietary intake data will be helpful in determining which factors are influencing the growth rate.
  - Feeding history about eating behaviors, feeding skills, feeding and environment. Identification of factors affecting intake such as preferences, chewing/swallowing problems, allergies, intolerances,
problems such as vomiting, diarrhea, constipation, or colic, usual appetite. The aim of feeding history is to reveal feeding problems or abnormal feeding patterns. For infants with an abnormal growth rate, assessing the feeding relationship for negative interactions associated with feeding that may be of help.

- Socioeconomic background – Food preparation and storage facilities, use of supplemental feeding and financial assistance programs, access to health care, and ethnic and/or cultural influences on the diet.
- Anthropometric Data – Anthropometric measurements, i.e., weight for age, length for age, weight for length, and head circumference for age.

In general, most healthy infants double their birth weight by 6 months of age and triple it by 12 months of age. However, there are normal differences in growth between healthy breastfed and formula-fed infants during the first year of life. After 3 months of age, the rate of weight gain in the breastfed infant may be lower than that of formula-fed infants, but differences are generally not reported between these infants for length and head circumference.

The assessment includes periodical plotting the infant's weight, length, and head circumference for age and weight for length on WHO growth standards charts throughout the first year of life.

- Biochemical Data – Data used to diagnose or confirm nutritional deficiencies or excesses; e.g. hemoglobin, hematocrit, or other hematological tests are performed to screen for iron deficiency anemia.

Nutritional needs

Infants differ in the amount of nutrients they ingest and store. Also, they differ in body composition, growth rates, and physical activity levels but generally the infant's growth rate represents a general indicator of the adequacy of food consumed. Infants with medical problems or special nutritional needs (such as metabolic disorders, chronic diseases, injuries, premature birth, birth defects, other medical conditions, or being on drug
therapies) may have different nutritional needs than healthy infants. Nutrient intake values (NIV) comprise a set of recommendations on dietary substrate supply for populations of healthy people. NIV provide an estimate for adequate nutrient provision to populations considered healthy, but they do not determine the optimal nutrient supply for an individual. They are used to assess intake data from dietary surveys and food statistics; to provide guidance on appropriate dietary composition, meal provision and food based dietary guidelines, they serve as the basis for national or regional nutrition policies, nutritional education programmers and food regulations and provide reference points for the labelling of food products if nutrient contents are expressed as a percentage of an NIV.

- PRI (also called reference nutrient intakes or RDA) are the levels of intake that meet the needs of almost all healthy individuals of a given age and sex group.
- The diet for healthy children should generally provide nutrient intakes matching the PRI, except for energy, where ANR provide guidance on appropriate intakes for groups.
- Children affected by disease or malnutrition, or those in whom catch-up growth is desired, may have nutrient needs that differ markedly from PRI.

Generally healthy infants are capable of regulating their food intake to consume the kilocalories they need. Thus, parents are generally advised to watch their infants’ hunger and satiety cues in making decisions about when and how much to feed. Nutrient needs per unit body weight of infants and young children are very high, because of the rapid rate of growth and metabolic rate during the first two years of life. Given the relatively small amounts of foods that are consumed at 6-24 months, the nutrient density (amount of each nutrient per 100 kcal of food) of the diet needs to be very high.
Studies suggest that a diet based predominantly on unfortified plant-based foods cannot meet the needs for certain micronutrients at this age, particularly iron, zinc, calcium and vitamin B12. Therefore, it is advisable to include milk products, as well as meat, poultry, fish or eggs, as often as possible.

**Energy**

The energy requirement of an individual is a level of energy intake from food that will balance energy expenditure when the individual has body size and composition and level of physical activity, consistent with long-term good health; and that would allow for the maintenance of economically necessary and socially desirable physical activity.

Infants need energy from food for activity, growth, and normal development. An infant’s energy requirement depends on many factors, including body size and composition, metabolic rate (the energy the body expends at rest), physical activity, size at birth, age, sex, genetic factors, energy intake, medical conditions, ambient temperature, and growth rate.
Energy comes from foods containing carbohydrate, protein, or fat.

**Carbohydrates**

Carbohydrates fall into these major categories: simple sugars or monosaccharides (e.g., glucose, galactose, fructose, and mannose), double sugars or disaccharides (e.g., sucrose, lactose, and maltose), and complex carbohydrates or polysaccharides (e.g., starch, dextrin’s, glycogen, and indigestible complex carbohydrates such as pectin, lignin, gums, and cellulose). Dietary fiber is another name for indigestible complex carbohydrates of plant origin (these are not broken down by intestinal digestive enzymes). Sugar alcohols, including sorbitol and mannitol, are also important to consider for infants.
Functions
Carbohydrates are necessary in the infant’s diet because they:
- Supply food energy for growth, body functions, and activity;
- Allow protein in the diet to be used efficiently for building new tissue;
- Allow for the normal use of fats in the body;
- Provide the building blocks for some essential body compounds.
Carbohydrates serve as primary sources of energy to fuel body activities while protein and fat are needed for building and storing.

Sources
The major type of carbohydrate consumed by young infants is lactose, the carbohydrate source in breast milk and cow’s milk-based infant formulas. Some infant formulas contain other carbohydrates in the form of modified corn starch, tapioca dextrin, or tapioca starch.
In later infancy, carbohydrates may derive from additional sources including cereal and other grain products, fruits, and vegetables.
Infants who consume sufficient breast milk or infant formula and appropriate complementary foods later in infancy will meet their dietary needs for carbohydrates.

Carbohydrates in Fruit Juices
Some fruit juices, such as prune, apple, and pear, contain a significant amount of sorbitol and proportionally more fructose than glucose.
Infants can absorb only a portion of the sorbitol (as little as 10 percent) and fructose in these juices.
Unabsorbed carbohydrate is fermented in the lower intestine causing diarrhea, abdominal pain, or bloating. These symptoms are commonly reported in infants and toddlers who drink excessive amounts of juice. For this and other reasons, infants up to 6 months of age should not be offered
fruit juice; infants over 6 months should be offered no more than 4 to 6 ounces daily of pasteurized, 100 percent juice from a cup. Fermentable carbohydrates also contribute to the development of tooth decay.

Fiber
Dietary fiber is found in legumes, wholegrain foods, fruits, and vegetables. Breast milk contains no dietary fiber, and infants generally consume no fiber in the first 6 months of life. As complementary foods are introduced to the diet, fiber intake increases; It has been recommended that from 6 to 12 months whole-grain cereals, green vegetables, and legumes be gradually introduced to provide 5 grams of fiber per day by 1 year of age.

Proteins
All proteins are combinations of about 20 common amino acids. Some of these amino acids are manufactured in the body when adequate amounts of protein-rich foods are eaten.
Nine amino acids that are not manufactured by the human body and must be supplied by the diet are called “essential” or “indispensable” amino acids. These include: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Protein quality is characterized high or low according to the indispensable amino acid (IAA) content. If the content of a single IAA in the diet is less than the individual's requirements, then it will limit the utilization of other amino acids and thus prevent normal rates of protein synthesis even when the total nitrogen intake is adequate. Thus, the 'limiting amino acid' will determine the nutritional value of the total nitrogen or protein in the diet.
Two other amino acids, cystine and tyrosine, are considered essential (conditionally essential) for the preterm and young term infant because enzyme activities involved in their synthesis are inadequate due to immaturity.
Functions
High quality protein from breast milk, infant formula, and/or complementary
foods is required to:
- Build, maintain, and repair new tissues, including tissues of the skin, eyes, muscles, heart, lungs, brain, and other organs;
- Manufacture important enzymes, hormones, antibodies, and other components;
- Perform very specialized functions in regulating body processes.
Protein also serves as a potential source of energy in cases the dietary caloric intake from carbohydrate or fat is insufficient. As with energy needs, protein needs for growth per unit of body weight are initially high and then decrease with age as growth rate decreases.

DRIs for Protein
The DRIs for protein were devised based on the intake of protein from breast milk for the exclusively breastfed infant 0–6 months old. Infant formula provides higher amounts of protein than breast milk, but the protein is not used as efficiently. The contribution of complementary foods to total protein intake in the second 6 months of infancy was considered in establishing the RDA for this age.

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Sources
Breast milk and infant formulas provide sufficient protein to meet a young infant's needs if consumed in amounts necessary to meet energy needs. In later infancy, sources of protein in addition to breast milk and infant formula include meat, poultry, fish, egg yolks, cheese, yogurt, legumes, and cereals and other grain products. When an infant starts receiving a substantial portion of energy from foods other than breast milk or infant formula, adequate protein has to be provided by the complementary foods. Proteins deriving from animal foods contain sufficient amounts of all the essential amino acids needed to meet protein requirements. In comparison, plant foods contain low levels of one or more of the essential amino acids. However, when plant foods low in one essential amino acid are eaten in combination with an animal food or other plant foods that are high in that amino acid e.g. Legumes such as pureed kidney beans -low in methionine, high in lysine- and grain products such as mashed rice -high in methionine, low in lysine-, sufficient amounts of all the essential amino acids are made available to the body. The protein eaten from the two foods would be equivalent to the high-quality protein found in animal products.

Protein Deficiency
In developing countries, infants who are deprived of adequate types and amounts of food for long periods of time may develop
- kwashiorkor, resulting principally from a protein deficiency
- marasmus, resulting from a deficiency of kilocalories
- marasmus-kwashiorkor, resulting from a deficiency of kilocalories and protein.

Lipids
Lipids include fats, oils, and fat-like substances, such as cholesterol. Fatty acids are the major constituent of many lipids. Fatty acids that must be provided in the diet to maintain health are called essential fatty acids.
Linoleic acid (abbreviated 18:2n-6 or LA) and α-linolenic acid (18:3n-3 or ALA) are both essential fatty acids. Small amounts of linoleic and α-linolenic acid must be provided in the diet.

Two other fatty acids, arachidonic acid (20:4n-6 or ARA) and docosahexaenoic acid (22:6n-3 or DHA), also known as long-chain polyunsaturated fatty acids (LCPUFA), are derived from linoleic acid and α-linolenic acid respectively. They are considered essential fatty acids only when linoleic acid and α-linolenic acid are lacking in the diet.

Functions

The fast growth of infants requires an energy-dense diet with a higher percentage of kilocalories from fat than is needed by older children. Infants require lipids in their diets because they
- Supply a major source of energy – fat supplies approximately 50 percent of the energy consumed in breast milk and infant formula;
- Promote the accumulation of stored fat in the body which serves as energy storage, insulation to reduce body heat loss, and as padding to protect body organs;
- Allow for the absorption of the fat-soluble vitamins A, D, E, and K; and
- Provide essential fatty acids that are required for normal brain development, normal eye development, healthy skin and hair, resistance to infection and disease.

Sources

Breast milk and infant formula are important sources of lipids, including essential fatty acids, during infancy. The lipid content of breast milk varies, but after about the first 2 weeks postpartum, breast milk provides approximately 50 percent of its calories from lipids. Infant formulas also provide approximately 50 percent of their calories as fat. Breast milk provides approximately 5.6 g/liter of linoleic acid, while infant formulas currently provide 3.3–8.6 g/liter.

In addition, breast milk provides approximately 0.63 g/liter of n-3 poly-
unsaturated fatty acids (including α-linolenic acid and docosahexaenoic acid) while infant formulas provide 0 to 0.67 g/liter. Manufacturers of infant formulas add blends of vegetable oils, which are high in linoleic acid, to improve essential fatty acid content. Food sources of lipids in the older infant's diet, other than breast milk and infant formula, include meats, cheese and other dairy products, egg yolks, and any fats or oils added to home-prepared foods.

Cholesterol and Fatty Acids in Infant Diets

Cholesterol performs a variety of functions in the body but is not an essential nutrient because it is manufactured by the liver. Cholesterol is not added to infant formulas whereas breast milk contains a significant amount of cholesterol. In recent years, there has been interest in whether the cholesterol content of breast milk has a beneficial or adverse effect on later development of atherosclerosis. It has been suggested that breast milk’s high level of cholesterol stimulates the development of enzymes necessary to prepare the infant’s body to process cholesterol more efficiently in later life.

No restriction of fat and cholesterol is recommended for infants<2 years when rapid growth and development require high energy intakes.

Trans fats, which are believed to be similar to saturated fats in their atherosclerotic affect, are found in fat that has been modified to a more solid form, such as polyunsaturated oils used to make spreadable margarine. They are present in most processed foods, but serve no physiologic purpose. Trans fats are not routinely used in the preparation of infant formulas.

In the last several years, interest has increased concerning the content of LCPUFA in breast milk versus infant formula. Of major interest are ARA and DHA, which are major fatty acids important for brain and retina development. Breast milk naturally contains ARA and DHA with levels varying according to the mother’s diet. Some infant formulas contain the precursors of DHA, ARA,
linoleic acid, and α-linolenic acid. Infants can make DHA and ARA from these precursors. Formula-fed infants have been observed to have lower plasma levels of ARA and DHA than breastfed infants, therefore questions have been posed about the formula-fed infant’s ability to synthesize these fatty acids.

Research demonstrating better cognitive function and visual acuity in breastfed infants has led to some support for the addition of ARA and DHA to infant formula.