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Breastfeeding and Infant Growth

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1. Introduction

Although it would be appropriate to consider various aspects related to the historical, social and cultural contexts, in a simplified manner it is possible to understand the child as a human being who is in a phase of life characterized by rapid growth and development. Thus, during this phase that starts with conception and continues until the beginning of adolescence, a child needs appropriate feeding, physical and emotional hygiene conditions, safety and protection, so that its genetic expression will fully manifest.

Growth, more than representing an increase in body mass size and in the number of cells, should be understood as a complex, continuous and dynamic process of interaction between the child and its environment, influenced by countless factors of a biological, environmental, emotional, cultural and social nature. Thus, growth represents an adaptation of body composition that results from all vital processes involved in the construction of the human body ^(1,2,3).

During the nursing phase, mainly during the first year of life, growth is directly related to nutrition and to various environmental factors. Thus appropriate feeding in terms of quantity and quality is a fundamental element for growth since the child will derive from it all the energy and the approximately fifty essential nutrients that will be used for the transformation and differentiation of structures, the consolidation of reserves, the repair of tissues, as well as for the protection of the organism against infectious and chronic-degenerative diseases ^(4,5).

2. The nutritional requirements of nursing infants

Due to their intense metabolism and rapid growth during the first two years of life, infants have high nutritional requirements. At 4 months of age, about 30% of the energy ingested is utilized for growth, with a reduction to 5% at the end of the first year of life and to 2% at 3 years. At birth, for example, the brain is responsible for about 65% of the basal metabolic rate, with this rate being reduced to 50% at the end of the first year of life ⁽⁶⁾.

To fulfill the requirements of an organism that grows from about 3.5 kg of weight and 50 cm in length at birth to almost 13 kg and 87 cm at the end of two years of life, macro- and

micronutrients of appropriate quantity and quality are necessary. In general, a child in good health and well fed should gain 25 to 30 grams per day in the first trimester of life, with its birth weight doubling between 4 and 5 months, tripling by 11 months to 1 year, and quadrupling by 2 years to 2 years and 3 months. Regarding length, a child should gain 15 centimeters in the first year of life and 10 centimeters in the second year ^(7,8).

For an appropriate occurrence of these somatic changes some recommendations should be followed in order to meet the nutritional requirements of the child during each growth phase in association with its life characteristics, since the period from six months to three years of life is the one during which a child is more subjected to nutritional risks.

The necessary quantity of daily calories may vary from 125 kcal/kg/day for newborns to 110 kcal/kg/day at six months of age and from 95 to 100 kcal/kg/day from six months to two years of age ^(9,10). The distribution of this energy consumption is presented in Table 1.

Energy consumption	kcal/kg/day
basal metabolism	50 - 55
growth in the 1st year of life	15 - 20
growth in the 2nd year of life	8 - 10
physical activity	20 - 30
specific dynamic action of food	5 - 8
excretions	8 - 10

Table 1. Daily energy consumption of nursing infants

The protein requirements range from 1.8 g/kg/day for the first six months to 1.5 g/kg/day in the second semester and 1.2 g/kg/day in the second year of life, considering proteins of high biological value that should account for about 15% of the total daily calorie intake.

Lipids should account for about 30% to 35% of the total daily calorie intake, supplying appropriate amount of the essential fatty acids, linoleic and linolenic acids, and carbohydrate should account for about 50% to 55% of the daily calorie intake. In addition to these nutrients, the feeding of an infant should also satisfy the requirements of water (150 ml/kg/day), vitamins and minerals ⁽⁴⁸⁾, as specified in Table 2 ^(7,9,10)

3. Breastfeeding and growth

There is an intimate relationship between physical growth and nutritional status which can be understood as the quantitative reflex of the food consumed daily by the child. According to the World Health Organization (WHO)⁽¹¹⁾, appropriate infant feeding should provide a sufficient quantity of food to cover the nutritional needs and to protect the airways against the aspiration of foreign substances and should not exceed the metabolic and functional capacity of the digestive tract and the renal system of the child.

There is a current consensus that breast milk as the exclusive food and offered freely satisfies all the needs of an infant during the first six months of age, being the only ideal food for the child’s growth and development ^(8,12,13). Universally supported and disseminated by the World Health Organization, the practice of breast-feeding finds important allies in Brazil in the National Program of Encouragement of Breast-feeding (PNIAM in the Portuguese acronym) of the Health Ministry and in the Departments of

Nutrient	Nutritional recommendations/day		Breast milk (quantity/100 ml)
	0 - 6 m	7 - 12 m	
Energy (kcal/kg/ day)	110	100 - 110	71 kcal
Protein (g)	2.1	2.1	1.2 g
Fat*	35 %	35 %	3.8 g
Carbohydrates **	50 %	50 %	7 g
Water (ml/kg/ day)	150	150	87.6 g
Calcium (mg)	400	600	33 mg
Iron (mg)	6	10	0.07 - 0.15 µg
Iodine (µg)	40	50	7 µg
Copper (mg)	0.4 - 0.6	0.6 - 0.7	40 µg
Chromium (mg)	10 - 40	20 - 60	50 ng
Manganese (mg)	0.3 - 0.6	0.6 - 1.0	0.6 µg
Selenium(mg)	10	15	1 µg
Fluorine (mg)	0.1- 0.5	0.2 - 1.0	16 µg
Zinc (mg)	5	5	300 µg
Magnesium (mg)	40	60	3 mg
Potassium (mg)	500	700	58 mg
Sodium (mg)	120	200	15 mg
Chlorine (mg)	180	300	42 mg
Phosphorus mg/dl	300	500	15 mg
Vitamin A (µg)	375	375	53 µg
Vitamin D (µg)	7.5	10	0.04 µg
Vitamin E (mg)	3	4	0.34 mg
Vitamin K (µg)	5	10	0.2 µg
Vitamin C (mg)	30	35	4.0 mg
Vitamin B1 (mg)	0.3	0.4	0.02 mg
Vitamin B2 (mg)	0.4	0.5	0.03 mg
Vitamin B6 (mg)	0.3	0.6	0.01 mg
Vitamin B12 (mg)	0.3	0.5	0.3 µg
Pantothenic acid (mg)	2	3	0.25 mg
Folic acid (µg)	25	35	5 µg
Niacin (mg)	5	6	0.2 mg

* 35% of total daily calories

** 50% of total daily calories

Table 2. Nutritional recommendations for infants younger than one year and biochemical composition of breast milk

Breast-Feeding and Nutrology of the Brazilian Society of Pediatrics. Thus, it is understood that breast milk, because of its quality, completeness, biological complexity and appropriate nutrient balance, guarantees the nutritional status, the growth and the development of nursing infants during the first months of life ^(14,15,16,17,18). This is the case even in the presence of unfavorable conditions ⁽¹⁹⁾, with no benefits having been found that compensate

for the risks and the disadvantages of introducing complementary foods before six months of life, which, in addition to being of poorer nutritional quality compared to breast milk, may be associated with contamination and the triggering of allergic diseases, interfering with the absorption of essential nutrients such as iron and zinc and therefore increasing infant morbidity and mortality ⁽²⁰⁾

The protective effects of breastfeeding are also evident in relation to other situations or diseases such as celiac disease, sudden infant death, neonatal hypocalcemia, acrodermatitis enteropathica, Crohn's disease, diabetes and cardiovascular disease, among many others, that every day is more described.

Although it is recognized that allergic diseases are related to various genetic and environmental components, in recent years breastfeeding has also been studied with respect to protective effects against atopic eczema, asthma and hay fever ^(21,22,23,24,25).

Bringing the infant to the breast has not only for mother and child the sense of satisfying hunger, there is much more, because the contact of the mouth with the breast and the child's body with the body of his mother bring warmth and comfort. This contact is very important to the child's psychological development in the first months of life. Mother, well aware of the reasons to breastfeed the child with pleasure, will release the endogenous beta-endorphin more reason, in this case pharmacologically demonstrated, to enhance this pleasure. Thus, it can be argued that breastfeeding promotes a strong bond between mother and child, with benefits for both stimuli, full of affection and bonuses and leading to a mother-child interaction at its most elevated and perfectly natural. Also, the infant has his sucking needs met, without the use of pacifiers, which can deform the teeth and palate, as well as facilitating contamination of the oral cavity. In addition, the breast feeding acts as a positive factor in the development of speech through early and continuous exercise of facial muscles. Studies suggest that learning ability and IQ of children exclusively breastfed, and adequate time, are higher than those not breastfed. Although these studies still need to proof, is visible to those who work and live with infants the distinct impression that those who are exclusively breastfed are more calm and smiling, and have more restful sleep than those who do not breastfeeding ^{26,27,28}.

Several studies published in the specialized literature have shown a positive association between the duration of the breast-feeding period and infant growth ^(29,30,31,32,33,34). Motil et al ⁽³⁵⁾ did not observe significant differences between infants exclusively breast-fed or receiving milk formulas, and concluded that the quantity of protein found in breast milk did not limit growth. Kramer et al ⁽³³⁾ demonstrated that infants who are exclusively breast-fed for a longer period of time can experience accelerated weight and length gain during the first months of life, showing no growth deficit at one year of age, or even growing more than infants fed artificial milk during adolescence ^(16,36).

By being a species-specific food, balanced and equilibrated in order to satisfy the needs of the infant and containing all the essential nutrients for growth and development, breast milk is one of the priorities in the fight against infant malnutrition^(37,38), with the practice of breast-feeding being established and widely disseminated as one of the Basic Actions for Infant Health since the Alma-Ata Conference in 1978.

Still in terms of nutritional disorders and being invested with great importance in the prevention of health problems in infancy and in future life, breast milk plays an important role regarding the problem of excessive weight gain. Studies by different investigators have demonstrated the protective role of breast milk against obesity in infancy and adolescence^(39,40,41) and have detected an association of a reduced prevalence of overweight and obesity with different feeding practices, demonstrating the protective effect of mother's milk^(42,43,44,45,46,47). An adequate duration of breastfeeding is associated with low prevalence of obesity during school age. Also, the excess of protein contained in infant formulas and consumed by early children may influence weight gain, indicating that as excessive increase of weight would be associated with high amount of protein of infant formulas^(48,49).

Although breast milk has low levels of iron, its high bioavailability makes it much more absorbed than other infant formulas. The finding of iron deficiency is not common in full-term children and breastfed, according to the Nutrition Committee of the American Academy of Pediatrics, although this fact is much more common in breastfed infants with cow's milk. Should be considered the possibility of iron supplementation after the sixth month of life for full-term children and when introducing complementary feeding. For those born prematurely or underweight, will be given iron supplements, even two years old⁽⁵⁰⁾. Calcium and phosphorus have lower levels in human milk, but the Ca / P in (around 2.2) is very favorable to the absorption of calcium. Breastfeeding and child's sun exposure in areas with good sunlight conditions are essential in the prevention of vitamin D deficiency.

Human growth, understood as a seasonal and pulsatile phenomenon characterized by different rates along time, can be assessed with the use of growth curves that provide references both for body growth as a whole and for the growth of different parts of the organism such as the head, the length of the limbs, the length of the trunk etc.

The instruments used to assess growth have been modified over time in order to better fit the conditions of infant populations since there is still discordance among authors about what should be used as reference or standard of infant growth. The various growth curves classically used, constructed for widely varying pediatric groups, when taken as reference do not always reflect the reality of each particular child since questions such as type of feeding, birth and health conditions during the first years of life, for example, can modify the parameters analyzed.

Starting in 2006, with the publication of the new growth curves of the WHO for children younger than 5 years, constructed with better defined criteria (singletons born at term to a non-smoking mother, with no diseases, exclusively breast-fed during the first six months of life and living under appropriate environmental and economic conditions) and therefore permitting to consider that all of these children will develop in a similar manner, we are able use an instrument that better represents the description of the physiological growth of these children from the beginning of life. More than a reference, these curves represent a growth pattern for children in this age range.

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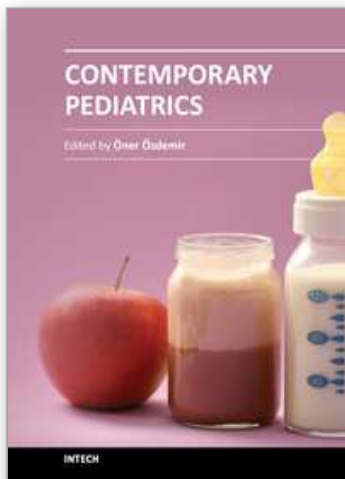
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