

# Newborn nutrition

According to WHO recommendations, the basis of nutrition for full-term newborns is breastfeeding, which is recommended to start in the first hours after birth. Exclusive breastfeeding is recommended until 6 months of age, and the only supplementation is vitamins D and K (vitamin K is only given if it was given orally instead of intramuscularly after birth). A fully breastfed baby does not need any additional food or other liquids during the first 6 months of life. In the next period, non-dairy foods are introduced during continued breastfeeding. <sup>[1]</sup> <sup>[2]</sup>

## Breastfeeding

 For more information see *Breastfeeding*.

### Benefits of breastfeeding

- optimal diet composition, which enables easy digestion and absorption of nutrients;
- creating a strong bond between mother and child (*bonding*);
- immunological factors, especially protection against bacterial and viral infections (mainly respiratory and gastrointestinal);
- prevention of civilization diseases (atherosclerosis, diabetes mellitus), reduced incidence of necrotizing enterocolitis, higher IQ of the child, lower incidence of breast and ovarian cancer of the mother.<sup>[2]</sup><sup>[3]</sup>

### Physiology of breastfeeding

Preparation of the mammary gland for breastfeeding takes place under the influence of estrogens throughout pregnancy. After childbirth, the blocking effect of the placenta is removed and milk begins to form due to the effect of prolactin. Lactation increases by stimulating the nipples by sucking the baby. The ejection of produced milk during breastfeeding is caused by the contraction of the myoepithelial cells of the milk ducts by the effect of oxytocin.

The frequency of breastfeeding is individual and should be guided by the needs and tastes of the child (on demand). A full-term newborn first reports breastfeeding after 2-3 hours. From the 4th day after birth, approx. 6-8 wet diapers per day are a reflection of sufficient fluid intake. The frequency of stools in breastfed children is very individual (several times a day to once a week).

Postnatal weight loss occurs after birth, which should not exceed 10% of birth weight and should balance out by 2 weeks of age.<sup>[2]</sup>

### Composition of breast milk

The composition of breast milk corresponds to the needs of the newborn. In the first days after birth, colostrum is formed, which is rich in immunoglobulins and has a lower lactose content. After a few days it turns into mature milk. The caloric value of breast milk is approximately 67 kcal/100 ml.<sup>[2]</sup>

#### Carbohydrates:

- 40% of caloric value
- mainly lactose (in colostrum 4%, in mature milk 7%); metabolized to glucose and galactose;
- galactose and fructose.

#### Proteins:

- the most stable component of breast milk (1.2-1.3 g/100 ml, of which nutritionally available proteins 0.9 g/100 ml);
- more than 70% are proteins whey (the main component is lactalbumin), the rest is casein;
- secretory IgA, lactoferrin and lysozyme pass through the digestive tract undigested;
- the ratio of whey protein and casein in nutritionally available protein is 40:60.

#### Fats':

- about 50% of the caloric value;
- variable content;
- unsaturated and polyunsaturated long-chain fatty acids (LCPUFA), which are essential for the development of the CNS and retina.

#### Vitamins:

- water-soluble vitamins contained in sufficient quantities;
- fat-soluble vitamins depend on the saturation of the mother's organism;
- the content of vitamin D and K is low, so it is necessary to supply it to the child.

#### Immune factors':

- secretory IgA – protects the intestinal mucosa against the invasion of pathogens;
- lactoferrin – inhibits the growth of intestinal pathogens;
- lysozyme – proteolytic effects on gram-positive bacteria and some viruses;
- macrophages, lymphocytes, neutrophil granulocytes and epithelial cells – cellular immunity.<sup>[2]</sup>

Expressed breast milk can be stored at 4 °C for 24 hours, or frozen at -20 °C for 6 months.<sup>[3]</sup>

## Contraindications to breastfeeding

### Inborn metabolic defects':

- galactosemia – absolute contraindication to breastfeeding;
- phenylketonuria and maple syrup disease – breast milk contains a small amount of phenylalanine; the child can be breastfed, but the level of phenylalanine or branched-chain amino acids (valine, leucine, isoleucine) must be monitored.

### Illness of the mother':

- Heart Failure;
- liver, kidney disease;
- rare psychiatric diseases – psychoses, lactational psychosis (so-called postnatal depression).

### Infectious disease of the mother':

- active tuberculosis;
- HIV (a contraindication for breastfeeding in Europe).

### Pharmacotherapy of the mother':

- psychostimulants, cytostatics, lithium, ergot alkaloids, radioisotopes, drugs (heroin, cocaine) are contraindicated;
- administration of radioisotopes and X-ray contrast agents requires a short-term interruption of breastfeeding;
- alcohol, nicotine and caffeine are relatively contraindicated.

In general, all drugs pass more or less into breast milk depending on the physical and chemical properties.<sup>[2]</sup>

## Artificial nutrition

 For more information see *Artificial nutrition of the infant*.

Artificial nutrition is indicated if breastfeeding is not possible. Exclusive milk formula is given up to 4 months of age, after which non-milk foods are gradually introduced from 4 to 6 months. From birth to 4-6 months, starter formulas are given and then follow-on formulas.

Formulas are prepared by '*adaptation of cow's milk*', which consists of the following modifications:

- reduction in protein content,
- changing the ratio of whey and casein to 60:40 (in cow's milk the ratio is reversed),
- increase in lactose content,
- milk fat is replaced by vegetable fat, i.e. enrichment with essential unsaturated fatty acids,
- reduction of salt content,
- fortification with vitamins, calcium, iron and trace elements.

## Special Formula

Depending on the individual needs of the child, it is possible to use special formulas:

### Antireflux' (AR):

- thickened with carob fiber,
- indicated for gastroesophageal reflux.

### Hydrolyzed Protein Formula:

- formula with a low degree of hydrolysis (HA)
  - hypoallergenic milks for the prevention of allergy development in at-risk children from families with a positive history of allergic disease;
- formula with a high degree of hydrolysis
  - heavily hydrolyzed proteins, sugars in the form of glucose polymers (maltodextrin), no lactose, fats in the form of MCTs,
  - indicated for malabsorption syndromes, lactase deficiency, cow's milk allergy, galactosemia;
- mixture of amino acids, maltodextrin and MCT fats (Neocate)
  - indicated for severe malabsorption, short bowel syndrome.<sup>[2]</sup>

### Formula for Immature Babies:

- increased energy content, higher protein content, part of the sugars are glucose polymers, contain essential fatty acids and long-chain polyunsaturated fatty acids, vitamins, trace elements and bone minerals; low osmolarity is maintained.

#### **Soy preparations<sup>1</sup>:**

- do not contain cow's milk protein and milk sugar;
- used for galactosemia, lactase deficiency, cow's milk allergy;
- a cross-allergy can also occur to soy protein.<sup>[2]</sup>

## **Nutrition of premature newborns**

A healthy newborn is equipped with reflexes for food intake (searching, sucking and swallowing) and their mutual coordination from the 32nd to 34th week of gestation. Breathing with swallowing, expressed breast milk or formula is given through a nasogastric tube.

Enteral nutrition is started early after birth. It starts with small doses, which are gradually increased with good tolerance. In very immature newborns, parenteral nutrition (glucose, amino acids, lipids, vitamins, trace elements) is started immediately after birth, which supplies them with a sufficient amount of nutrients, energy and fluids. During the following days, enteral intake is gradually increased and supplementary parenteral nutrition is reduced. After the transition to full enteral nutrition, fortification is added to breast milk.

Contraindications to early initiation of the diet are vomiting, biliary residues in the stomach, distended, poorly palpable abdomen, tachypnea (risk of aspiration). With perinatal asphyxia, polycythemia and congenital heart defects, there is a higher risk of developing necrotizing enterocolitis.<sup>[4]</sup>

## **NNPH nutrition after discharge to home care**

The growth of newborns with low birth weight (NNPH) early after birth is negatively affected for various reasons, and these children usually have a lower weight and length at birth than full-term newborns. This phenomenon is called EUGR — *extrauterine growth restriction*. The most at-risk group are newborns with very low and extremely low birth weight (NVNPH and NENPH). The goal of nutrition is to normalize growth and optimize body composition. These children often have extremely high nutritional and mineral needs. Protein-energy and mineral deficit has a negative effect on psychomotor development.<sup>[5]</sup>

Newborns with adequate growth and early postnatal catch-up (growth spurt) usually do not require special nutritional intervention. Newborns with IUGR (*intrauterine growth restriction*) without early postnatal catch-up are a slightly more at-risk group. The most at-risk group are newborns born as eutrophic, but with postnatally formed EUGR. This group almost always requires nutritional intervention.<sup>[5]</sup>

### **Breastfeeding**

Breastfeeding or feeding with expressed breast milk is the ideal form of nutrition. In NNPH, rigorous monitoring of growth parameters (weight, length, head circumference) and mineral and bone metabolism is necessary. Newborns with EUGR often require fortification of breast milk or a combination of breastfeeding with post-discharge formula, mineral supplementation, etc.

### **Premature Infant Formula**

NNPH who cannot be breastfed are recommended to be fed with formulas for premature babies, until the 40th gestational week is completed or until they reach a weight of 3500 g.<sup>[5]</sup>

### **Initial Formula**

NNPH with adequate growth, early postnatal catch-up and IUGR who cannot be breastfed can be fed with initial formula from about the 38th gestational week.<sup>[5]</sup>

### **Post-discharge formula**

Post-discharge formulas are intended for newborns with EUGR, or IUGR who cannot be breastfed or do not receive a sufficient volume of breast milk. The optimal length of administration of these formulas is not known.<sup>[5]</sup>

### **Introduction of complementary foods**

For babies born after the 35th week of pregnancy, food is introduced in the same way as for full-term babies. For children born before the 35th week of pregnancy, solid foods can be introduced 5-8 months from the date of birth, no earlier than after the end of the 3rd month (13th week) of the corrected age of the child. The introduction of complementary foods is assessed individually according to the state of health, psychomotor maturity and development.<sup>[5]</sup>

## **Links**

## Related Articles

- Children's nutrition: Newborn nutrition • Breastfeeding • Infant artificial nutrition • Non-dairy infant food • Toddler nutrition • Preschool, school nutrition children and youth • Recommendations for infant nutrition 2011 • Recommended nutrient intake (pediatrics)
- Nutrition recommendations: Nutrition recommendations (1. LF UK, NT) • Nutrition recommendations for the adult population • Nutrition for pregnant and lactating women • Nutrition in old age • Factors affecting nutritional needs
- Special Nutrition
- Food composition: Carbohydrates in food • Proteins in food • Fats in food • Mineral substances in food • Trace elements in food • Vitamins • Microorganisms in food • Foreign substances in food
- Failure to thrive • Eating disorders • Nutrient excess or deficiency disease • Food allergy • Food intolerance • Cow's milk protein allergy

## References

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3. GOMELLA, T. L - KOLEKTIV,. *Neonatology : Management, Procedures, On-Call Problems, Diseases, and Drugs*. 6. edition. Lange, 2009. pp. 95-96. ISBN 0071638482.
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5. Working Group on Pediatric Gastroenterology and Nutrition. Recommendations of the gastroenterology and nutrition working group of the CPS for the nutrition of infants and toddlers. *Czech-Slovak Pediatrics*. 2014, vol. April, p. 18-21, ISSN 0069-2328.