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V. N. Karazin Kharkiv National University

FEEDING OF CHILDREN OF EARLY AGE

Methodical recommendations
for students of higher education of the 3rd year of study
in the discipline «Propaedeutics of Pediatrics»

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F 32

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LIST OF ACRONYMS

WHO – World Health Organization

AAP – The American Academy of Pediatrics

UNICEF – United Nations Children's Fund

FDA – United States Food and Drug Administration

INTRODUCTION

No matter where a newborn takes his or her first breath, the desire to give that baby the best start in life is universal. The first hours and days after birth are one of the riskiest periods of a child's life – but getting an early start to breastfeeding offers a powerful line of defense.

(WHO)

All major health organizations recommend breastfeeding as the optimal source of infant nutrition. After six months, complementary foods may be introduced. Most organizations recommend breastfeeding for at least one year, and the World Health Organization recommends a minimum of two years.

WHO and **UNICEF**'s global recommendations for optimal infant feeding as set out in the Global Strategy are:

- ✓ *exclusive breastfeeding* for 6 months (180 days)
- ✓ nutritionally adequate and safe *complementary feeding* starting from the age of 6 months with continued breastfeeding up to 2 years of age or beyond.

Exclusive breastfeeding means that an infant receives only breast milk from his or her mother or a wet nurse, or expressed breast milk, and no other liquids or solids, not even water, with the exception of oral rehydration solution, drops or syrups consisting of vitamins, minerals supplements or medicines.

Complementary feeding is defined as the process starting when breast milk is no longer sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids are needed, along with breast milk. The target range for complementary feeding is generally taken to be 6 to 23 months of age, even though breastfeeding may continue beyond two years.

The American Academy of Pediatrics (AAP) recommends breastfeeding as the sole source of nutrition for your baby for about 6 months and can be continued for as long as both mother and baby desire it.

Infants should be breastfed on demand – that is as often as the child wants, day and night. No bottles, teats or pacifiers should be used.

Breastmilk is the ideal food for infants. It is safe, clean and contains antibodies which help protect against many common childhood illnesses. Breastmilk provides all the energy and nutrients that the infant needs for the first months of life, and it continues to provide up to half or more of a child's nutritional needs during the second half of the first year, and up to one third during the second year of life.

Breastfed children perform better on intelligence tests, are less likely to be overweight or obese and less prone to diabetes later in life. Women who breastfeed also have a reduced risk of breast and ovarian cancers.

Inappropriate marketing of breast-milk substitutes continues to undermine efforts to improve breastfeeding rates and duration worldwide.

BREASTFEEDING

Only one chance for the best start

Neonatal period begins from the birth of the baby, extends until 28 days after birth. The majority of infants are born between 37 weeks (259 days) and 42 weeks (294 days) and are referred to as term infants. Preterm infants are those born before 37 weeks while post-term infants are born on or after 42 weeks. Infants are no longer described as premature or post-mature.

The WHO and the UNICEF recommend that children initiate breastfeeding within the first hour of birth and be exclusively breastfed for the first six months of life – meaning no other foods or liquids are provided, including water.

The early initiation of breastfeeding – putting newborns to the breast within the first hour of life – is critical to newborn survival and to establishing breastfeeding over the long term. When breastfeeding is delayed after birth, the consequences can be life-threatening – and the longer newborns are left waiting, the greater the risk

Ten Steps to Successful Breastfeeding (revised 2018) by WHO

1a. Comply fully with the International Code of Marketing of Breast-milk Substitutes and relevant World Health Assembly (WHA) resolutions (the Code).

1b. Have a written infant feeding policy that is routinely communicated to staff and parents.

1c. Establish ongoing monitoring and data management systems.

2. Ensure staff has sufficient knowledge, competence and skills to support breastfeeding. Key clinical practices

3. Discuss the importance and management of breastfeeding with pregnant women and their families.

4. Facilitate immediate and uninterrupted skin-to-skin contact and support mothers to initiate breastfeeding as soon as possible after birth.

5. Support mothers to initiate and maintain breastfeeding and manage common difficulties.

6. Do not provide breastfed newborns any food or fluids other than breast milk, unless medically indicated.

7. Enable mothers and their infants to remain together and to practise rooming-in 24 hours a day.

8. Support mothers to recognize and respond to their infants' cues for feeding.

9. Counsel mothers on the use and risks of feeding bottles, teats and pacifiers.

10. Coordinate discharge so that parents and their infants have timely access to ongoing support and care

Composition of human milk

Breast milk contains all the nutrients that an infant needs in the first 6 months of life, including fat, carbohydrates, proteins, vitamins, minerals and water. It is easily digested and efficiently used. Breast milk also contains bioactive factors that augment the infant's immature immune system, providing protection against infection, and other factors that help digestion and absorption of nutrients. Human milk is commonly distinct into colostrum, transitional and mature milk.

However, it has to be taken into account that this classification refers to the gradual changes that occur in human milk according to stage of lactation rather than indicating specific classes of milk. Colostrum is the milk produced in the first few days, a relatively denser milk characterized by high concentrations of protein and antibodies. The transition to mature milk begins around days 3 to 5 postpartum with the onset of lactogenesis II, and mature milk appears by about day 10 postpartum.

Colostrum contains a high concentration of whey proteins, with casein being almost undetectable, whereas the lactose and fat content is lower compared to that in mature milk. One of the main features of colostrum is represented by the high concentration in bioactive compounds, including secretory immunoglobulin (IgA), lactoferrin and leukocytes. The high content of secretory immunoglobulins indicates that the main role of colostrum is immunologic rather than nutritional.

The protective function of colostrum is further underlined by the particularly high content of oligosaccharides, that approximately doubles that of mature milk, decreasing from 21 g/100 mL on the 4th day to 13 g/100 mL at the end of the second month of lactation. Colostrum may also act as growth promoter, since it contains high concentrations of epidermal growth factor, TGF- β and colony stimulating factor. After 5 days, colostrum will be gradually replaced by transitional milk which shares some features of colostrum and supports infants' growth and development. From the second week after delivery, milk is considered largely mature, becoming fully mature by the 4th to the 6th week.

Constituent (per liter) Mature Milk (after 2 weeks' lactation)

Energy (kcal)	600—700
Macronutrients	
Lactose (g)	67—70
Oligosaccharides (g)	12—14
Total nitrogen (g)	1.9
Nonprotein nitrogen (% total nitrogen)	23
Protein nitrogen (% total nitrogen)	77
Total protein (g)	9
Total lipids (g)	35
Triglyceride (96 total lipids)	97—98
Cholesterol (96 total lipids)	0.4-0.5
Phospholipids (96 total lipids)	0.6—0.8

Water-Soluble Vitamins	
Ascorbic acid (mg)	100
Thiamin (pg)	200
Riboflavin (µg)	400—600
Niacin (mg)	1.8—6.0
Vitamin B6 (mg)	0.09—0.3
Folate (µg)	80—400
Vitamin B12 (pg)	0.5-1.0
Pantothenic acid (mg)	2-5
Biotin (pg)	5-9
Fat-Soluble Vitamins	
Retinol (mg)	0.3-0.6
Carotenoids (mg)	0.2-0.6
Vitamin K (pg)	2-3
Vitamin D (pg)	0.33
Vitamin E (mg)	3-8
Calcium (mg)	200-250
Magnesium (mg)	30-35
Phosphorus (mg)	120-140
Sodium (mg)	120-250
Potassium (mg)	400-580
Chloride (mg)	400-480
Iron (mg)	0.3—0.9
Zinc (mg)	1—3
Copper (mg)	0.2—0.4
Manganese (mg)	3
Selenium (pg)	7-33
Iodine (pg)	150
Fluoride (pg)	4-15

The protein quality of human milk differs greatly from that in bovine milk. Human milk is 70 % whey and 30 % casein, whereas ovine or cow milk is 48 % whey and 52 % casein.

The major carbohydrate in human milk is lactose, a disaccharide that increases in content as lactogenesis progresses from colostrum to mature milk. The lactose content of mature milk remains relatively constant. A small proportion of the lactose is not absorbed. This unabsorbed lactose promotes a softer stool consistency, reduced pathogenic bacterial fecal flora, and improved absorption of minerals. Oligosaccharides are carbohydrate polymers that comprise approximately 5 % to 10 % of total carbohydrates in human milk. There are more than 100 different oligosaccharides in human milk. In addition to their role in nutrition, oligosaccharides exert an important role in host defense of the infant as “prebiotic” agents.

Lipids represent the major sources of energy, contributing to the 44 % of the total energy provided by human milk. The lipid system in human milk is comprised of an organized milk fat globule, a bile salt stimulated lipase, and an abundance of essential fatty acids (linoleic and linolenic acids). Furthermore they are an important source of essential nutrients such as polyunsaturated fatty acids (PUFA), lipid soluble vitamins, complex lipids and bioactive compounds.

Human milk is particularly rich in microRNAs, which are potentially involved in infant protection and development. MicroRNAs are small non-coding RNA molecules, that regulate gene expression at the post-transcriptional level, modulating several cell functions such as cell cycle, proliferation, differentiation, apoptosis, and immune response. Human milk has also been identified as the first probiotic food fed to the infants since it contains a diverse microbial community including >200 phylotypes.

However, it has not been clearly elucidated how these bacteria reach the mammary gland and are finally incorporated into human milk. Studies suggest that an enteromammary pathway brings bacteria that are present in the maternal gut to the mammary gland via lymph and blood circulation. Recent research also indicates that the cellular fraction of human milk includes not only immune cells but also non immune ones, such as stem cells.

The specific functional role associated with stem cells is not known; however, this finding suggests potential developmental benefits to the breast-fed infant. Human milk contains also hormones that are acknowledged to modulate metabolism and body composition, such as insulin, leptin, adiponectin, ghrelin. Particularly, leptin milk concentration has been found to be directly correlated with maternal body mass index.

Anatomy and physiology of lactation

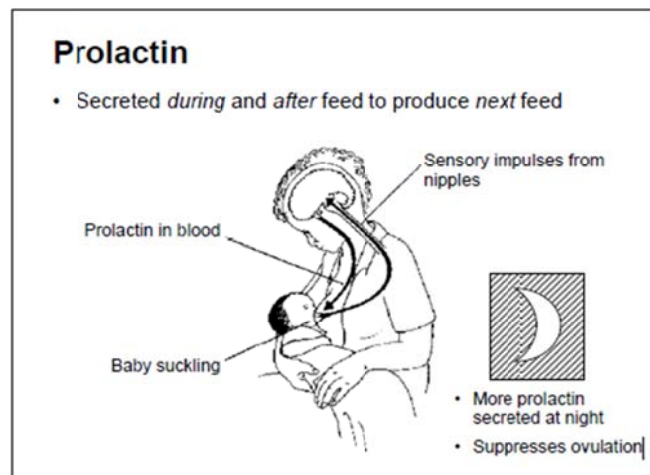
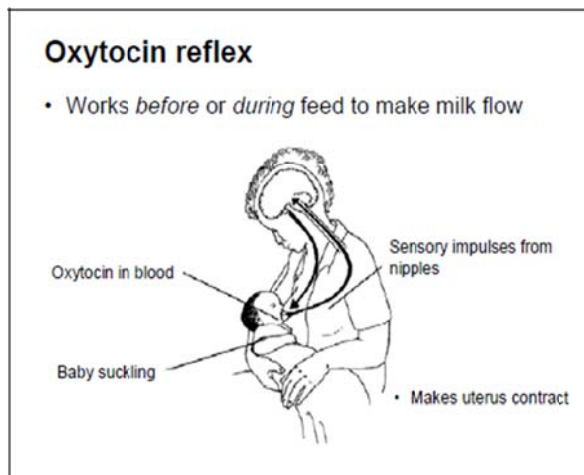
The breast structure includes the nipple and areola, mammary tissue, supporting connective tissue and fat, blood and lymphatic vessels, and nerves.

The mammary tissue – This tissue includes the alveoli, which are small sacs made of milk-secreting cells, and the ducts that carry the milk to the outside.

Nipple and areola – The nipple has an average of nine milk ducts passing to the outside, and also muscle fibres and nerves. The nipple is surrounded by the circular pigmented *areola*, in which are located *Montgomery's glands*. These glands secrete an oily fluid that protects the skin of the nipple and areola during lactation, and produce the mother's individual scent that attracts her baby to the breast. The ducts beneath the areola fill with milk and become wider during a feed, when the oxytocin reflex is active.

There are two hormones that directly affect breastfeeding: *prolactin* and *oxytocin*. A number of other hormones, such as oestrogen, are involved indirectly in lactation. When a baby suckles at the breast, sensory impulses pass

from the nipple to the brain. In response, the anterior lobe of the pituitary gland secretes prolactin and the posterior lobe secretes oxytocin.



In response, the pituitary gland at the base of the brain secretes prolactin. Prolactin goes in the blood to the breast, and makes the milk-secreting cells produce milk. The more a baby suckles the more milk the breasts produce.

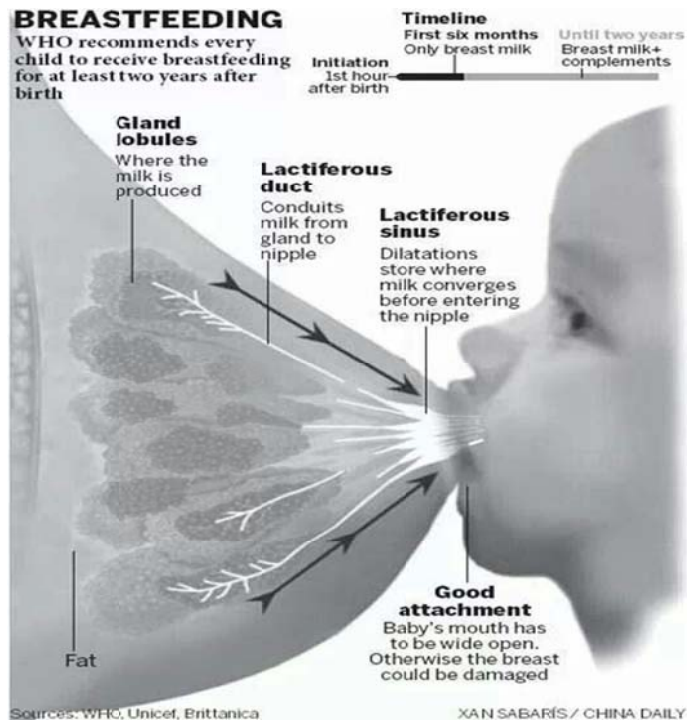
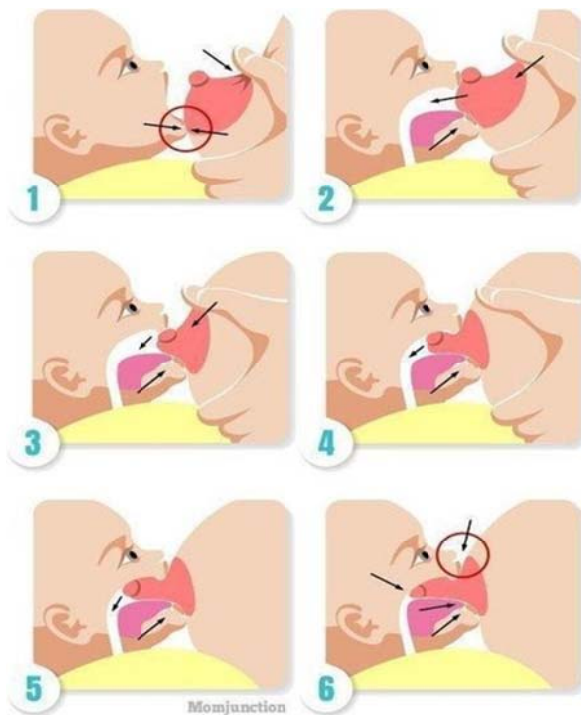
Most of the prolactin is in the blood about 30 minutes after the feed – so it makes the breast produce milk for the next feed. For this feed, the baby takes the milk which is already in the breast.

In response, the pituitary gland at the base of the brain secretes the hormone oxytocin. Oxytocin goes in the blood to the breast, and makes the muscle cells around the alveoli contract. This makes the milk which has collected in the alveoli flow along the ducts to the larger ducts beneath the areola. Here the milk is stored temporarily during the feed. This is the *oxytocin reflex*, the milk ejection reflex or the «*let-down*» reflex. Oxytocin is produced more quickly than prolactin. It makes the milk in the breast flow for *this* feed. Oxytocin can start working before a baby suckles, when a mother learns to expect a feed. If the oxytocin reflex does not work well, the baby may have difficulty in getting the milk. It may seem as if the breasts have stopped producing milk. However, the breasts are producing milk, but it is not flowing out.

To stimulate the nipple and remove milk from the breast, and to ensure an adequate supply and a good flow of milk, a baby needs to be well attached so that he or she can suckle effectively. Difficulties often occur because a baby does not take the breast into his or her mouth properly, and so cannot suckle effectively.

The 4 key points of attachment are:

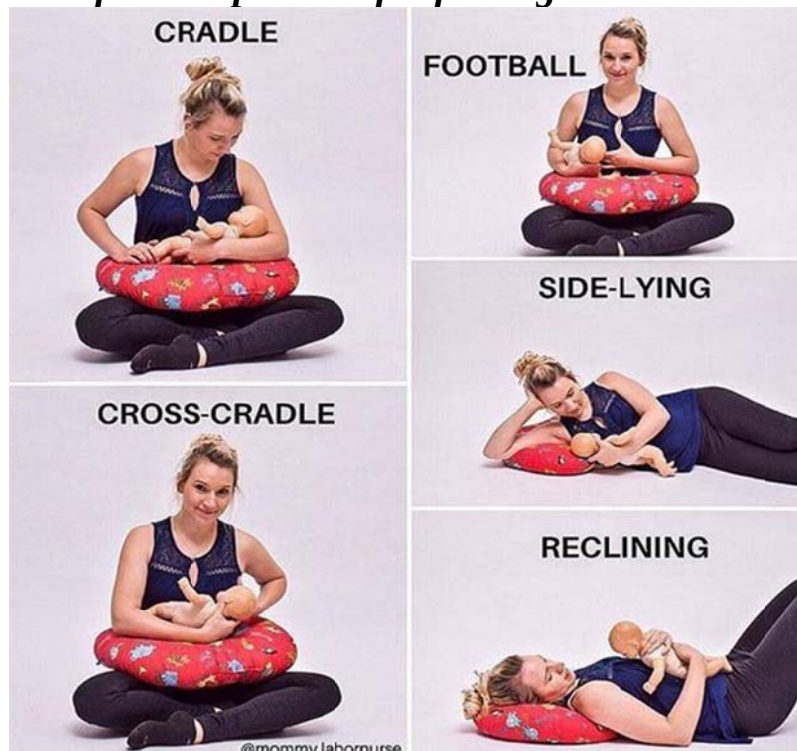
1. More areola above baby's top lip than below bottom lip
2. Baby's mouth wide open
3. Lower lip turned outwards
4. Baby's chin touches breast



Reflexes in the baby

There are three main reflexes – the **rooting reflex**, the **sucking reflex**, and the **swallowing reflex**. When something touches a baby's lips or cheek, he opens his mouth and may turn his head to find it. He puts his tongue down and forward. This is the 'rooting' reflex. It should normally be the breast that he is 'rooting' for. When something touches a baby's palate, he starts to suck it. This is the sucking reflex. When his mouth fills with milk, he swallows. This is the swallowing reflex. All these reflexes happen automatically without the baby having to learn to do them.

The most comfortable position for feeding:



Lactation crises

Lactation crisis is a temporary decrease in the amount of milk due to the periodicity of hormonal regulation in combination with increased physical activity of women and intensive growth of the child. Lactation crises mainly occur in the 3rd-6th week, 3rd, 4th, 7th and 8th months of lactation (they can be repeated every 1.5-2 months). The duration of such crises is on average 3-4 days / up to a week /, they are completely "reversible" - that means, the process of normal lactation can be completely restored - and do not affect the health of the child. In some women, lactation crises occur several times during the entire period of breastfeeding.

It is recommended to rely on two precise indicators, which can determine the insufficient amount of breast milk received by the child:

- **weight gain.** If the baby gains 125 g per week (≥ 500 g / month), it means that the baby has enough milk.

- **frequency of urination per day.** The number of urination in a child older than 10 days is at least 10-12 per day. Or replace about 6 well-filled diapers per day.

Bad weight gain? LOOKING FOR A REASON!

In 97 % of cases, a woman's body produces the amount of milk needed for a baby if you follow certain feeding rules:

1. *Properly apply the baby to the breast.* If applied correctly, it does not hurt to feed the mother, she does not have cracks. Thanks to the correct, deep application, the child has the opportunity to effectively empty the breast. In this case, the principle of "demand generates supply" twitches and the required amount of milk comes each time. If the baby sucks the mother's breast through the pad, the baby is given a pacifier - this spoils the application and disrupts the natural stimulation of lactation.

2. *Breastfeed your baby often during the day.* It is known that due to the hormone prolactin in a woman's body produces milk. If there is a lot of prolactin, there is a lot of milk. And prolactin will be a lot if the baby is often applied to the breast (it is produced in response to breastfeeding). Therefore, it is recommended to apply the baby to the breast often. The first months – at least once every 2 hours.

3. *Be sure to feed your baby at night.* Night feedings allow the mother's body not to stop working on milk production, but to produce so much milk that lactation is not reduced. From 24:00 to 8:00 the mother should have 3-4 feedings.

FORMULA FEEDING

Supplementary feeding is the required amount of food that a baby receives in addition to breast milk in case of lack of it. That is, the question of supplementation arises as an inevitable consequence of the lack of milk in the mother. Usually feeding is recommended in the following cases:

The newborn:

- If the baby cannot suck – for any reason.
- Loss of body weight by the child after birth more than 10 %. Because weight loss is common to all newborns, it is called physiological and is in full-term infants about 6-9 % of initial weight. The higher the weight of the baby at birth – the greater the absolute weight loss. The maximum weight loss occurs on the 3-4th day of life, after which its gradual recovery begins.
- If the baby has not gained weight at birth within the first 14 days. By the 10-15th day of life, most full-term babies regain their birth weight.
- The baby continues to lose weight after the first week of life.
- Lack of either a very small amount of stool, or if the meconium has not yet come out 4-5 days after birth.
- Excretion of concentrated urine in small quantities – the child urinates less than 6 times a day, urine is dark, with a pungent odor.

In children aged from 1 month:

- A small amount of urine;
- The child's weight does not rise above the 3rd percentile for the second month in a row;
- Too much weight loss due to illness;
- The child adds little or no height and head circumference;
- The child shows signs of starvation and / or dehydration:
 - Inflamed temple,
 - gray skin color,
 - severe drowsiness,
 - loss of fat under the skin.

As a rule, the need for supplementation indicates the presence of several of these indicators.

Types of supplementary feeding (in order of priority):

- ✓ Breast milk (possibly stored in advance and frozen).
- ✓ Donor breast milk. Unfortunately, we do not yet have a common practice of donor breast milk banks (there is a useful resource <http://milk mama.info/>), or if you have the opportunity – find a nursing mother who lives near you, for a short time, until you adjust lactation is still better than a mixture.
- ✓ Highly adapted artificial mixture.
- ✓ If the baby is older than 5-6 months and still needs to be fed, it is not necessary to use the mixture: he can get extra calories with food.

*The simplest option is a bottle. However, it is better to use a **spoon, pipette, drinker, or special devices for breastfeeding.***

Indications for infant formula

Children who should not receive breast milk, except for special mixtures:

- with classic galactosemia: special formulas containing galactose are required.

- with maple syrup (valinoleucinuria): special formulas containing leucine, isoleucine and valine are required.
- with phenylketonuria: special formulas that do not contain phenylalanine are required (partial breastfeeding is possible after careful monitoring).

Infants for whom breast milk remains the best food, but who may need supplementary breast milk for a limited period of time:

- Babies born with extremely low body weight (less than 1500 g).
- Babies born at gestational age less than 32 weeks (premature babies).
- Newborns with high risk of hypoglycaemia as a result of impaired adaptation or increased glucose requirements if their blood sugar levels fall despite breastfeeding or breastfeeding. As a rule, these are premature babies, with a short gestational age and significant intrauterine hypoxic / ischemic stress, sick and newborns from mothers with diabetes.

Maternal conditions that may be an indication to stop breastfeeding: HIV infection – if it is possible to replace it with an acceptable, real, affordable, permanent and safe diet (AFASS).

Maternal conditions that may be an indication for temporary cessation of breastfeeding:

- Severe illnesses that prevent the mother from caring for her baby (such as sepsis).
- Herpes simplex virus type I (HSV-I): direct contact of the herpes-affected part of the breast with the newborn's lips should be avoided until this active form of the lesion has healed.

Mother's use of medication:

- sedative psychotherapeutic, antiepileptic drugs and opioids or a combination of them can cause side effects such as drowsiness and respiratory depression; the use of these drugs is best avoided if a safer alternative is possible;
- radioactive iodine-131 is best avoided if a safer alternative is possible – the mother can resume breastfeeding two months after changing the drug;
- intensive use of topical iodine or iodophors (eg povidone-iodine), especially through an open wound or mucous membranes, may lead to thyroid dysfunction or electrolyte imbalance in breastfed infants;
- the use of cytotoxic chemotherapy requires cessation of breastfeeding for the duration of therapy.

The condition of mothers in whom it is possible to continue breastfeeding, although health problems require solutions:

- Breast abscess - breastfeeding should be continued by an uninfected breast; breastfeeding can be resumed immediately after treatment.
- Hepatitis B: Infants should be vaccinated with the hepatitis B vaccine within 48 hours of birth or as soon as possible.
- Hepatitis C.

- Mastitis: If breastfeeding causes pain, breast milk may be expressed to prevent progression.
- Tuberculosis: mothers and children require management in accordance with national guidelines.

Drug use:

- it has been proven that mothers' use of nicotine, alcohol, ecstasy, amphetamine, cocaine and other stimulants has a negative impact on the health of breastfed infants;
- Alcohol, opioids, benzodiazepines and marijuana (anasha, hashish, "grass") can cause a sedative effect in both mother and child.

Types of formula. No brand of infant formula is best for all babies. You should pick an infant formula that is made especially for babies. The FDA regulates commercial infant formulas to make sure they meet minimum nutritional and safety requirements. Commercial infant formulas come in liquid and powdered forms.

There is no single classification of infant formula. By appointment, they are divided into: basic, preventive (functional) and for treatment (specialized).

Infant formulas are divided for different ages:

- 0 – for premature / immature newborns
- 1 (first infant formula/first milk) – for children aged 0-6 months
- 2 from 6-12 months (Follow-on formula)
- 3 – from 1-2 years (toddler milk)
- 4 – for children older than 2 years.

Most infant formula is made from cow's or goat's milk. Soy's formulas are not recommended because they are not highly adapted. Formula comes in 2 different forms: a dry powder you make up with water, or a ready-to-feed liquid formula. The cows' milk in formula contains 2 types of proteins – whey and casein. First infant formula is based on whey protein/casein from 80/20 to 60/40 which is thought to be easier to digest than other types of formula. Formulas with a ratio of 50/50 or with a predominance of casein, as a rule, are as follows or are used to reduce vomiting. Sometimes whey protein may predominate in subsequent formulas – this is allowed.

Different kinds of goats' milk formula are available in pharmacies and shops. They are produced to the same nutritional standards as cow's milk-based formula. Goats' milk formula *is not less likely to cause allergies* in babies than cows' milk formula. Goats' milk formulas are not suitable for infants with cows' milk allergy (also *known as cows' milk protein allergy*), as the proteins they contain are very similar.

Preventive (Functional) formulas: *Comfort formula.* Suitable from birth (only after your recommended). This type of formula contains cows' milk proteins that have already been partly broken down (partially hydrolysed). This is supposed to make it easier to digest and help prevent digestive problems such

as colic and constipation. However, there's no evidence for this. Partially hydrolysed formulas are not suitable for babies who *have cows' milk allergy*.

Hypoallergenic formula. Suitable from birth (but only under medical supervision). If baby is diagnosed as being allergic to cows' milk, a GP should prescribe an appropriate infant formula with fully hydrolysed (broken down) proteins. *Extensively Hydrolyzed Formulas.* These are fancy words to describe a formula with proteins that are mostly (not fully) broken down. Often milk protein intolerance is suspected if the infant vomits excessively, has lots of stomach upset with excessive gas and sometimes, diarrhea. These infants also often cry, arch with feedings and appear uncomfortable.

Low-lactose formula. In these formulas, the level of lactose is reduced, but it is necessarily present in them. Some formulas from the category of "comfortable digestion" have a low level of lactose and have the properties of low-lactose mixtures. But there are special ones, which are called "low-lactose". They should not be confused with lactose-free formulas, which are therapeutic. Lactose is a very important component in a child's diet. In addition to the positive effects on the child's intestines (formation of normal microflora, intestinal stimulation, etc.), lactose is important for the development of the central nervous system. Low-lactose formulas are used in mild (transient) lactase deficiency, when transferring a child from a lactose-free mixture (lactose-free-> low-lactose-> standard mixture). Low-lactose formulas have nothing to do with the treatment of allergies in children. Using these formulas for this purpose is a mistake.

Fermented milk adapted formula. These are formula for "gourmets". Given the diversity currently in each firm of different functional, standard and therapeutic formulas, fermented milk is an alternative to dairy formulas. In part, these formula have effects that have the above functional, low-lactose and hypoallergenic formula. On the other hand, it is a great alternative to regular yogurt. All sour-milk formulas are enriched and adapted for babies, do not cause "acidification" of an organism of the child unlike kefir and its analogs.

Specialized (therapeutic) formulas. *Preterm Infant Formula:* Preterm infants come with their own special nutrition and medical needs which causes them to fall into a special category of infant formula. These formulas have a higher concentration of calories and bone minerals. Preterm infants do not have the opportunity to build up fat or bone mineral stores prior to birth during the 3rd trimester. Most of these formulas come as 22 calories per ounce and are often concentrated further to 24 calories per ounce by the medical team.

Anti-reflux (staydown) formula. Suitable from birth (but only under medical supervision). This type of formula is thickened with the aim of preventing reflux in babies (when babies bring up milk during or after a feed).

Lactose-free formula. Suitable from birth (but only under medical supervision). This formula is suitable for babies who are lactose intolerant. This

means they cannot absorb lactose, which is a sugar that's naturally in milk and dairy products. Lactose intolerance in babies include such symptoms as diarrhoea, abdominal pain, wind and bloating.

Highly hydrolyzed formula. In these formulas, cow's milk protein is cleaved – hydrolyzed. Due to this, highly hydrolyzed formulas have a specific smell and taste. Highly hydrolyzed formulas are used only for therapeutic purposes – nutrition of children with acute intestinal infection, allergic dermatitis, malabsorption syndrome; after bowel surgery; in diseases of the liver and bile ducts, malnutrition, cystic fibrosis, congenital heart disease, etc. All these conditions require the gentlest effect on the intestinal mucosa of the child, facilitated absorption and sparing of the enzymatic system. Maximum cleavage of cow's milk protein allows to achieve these goals. Additionally, medium-chain triglycerides are added to a number of formulas, which do not require cleavage by enzymes for absorption. This allows you to save the most energy of the child when digesting the formula. Due to this, the child can better gain weight. This position is especially important for children with malnutrition, various heart defects and diseases of the biliary tract and liver.

As a rule, lactose is significantly reduced or completely absent in highly hydrolyzed formulas, which allows to use these formulas for feeding a child during the period of acute intestinal infection and in the following days after it. All other micro- and macronutrients, vitamins are present in these formula in permitted amounts. These formula are used for enrichment (fortification) of breast milk when feeding premature babies. Also, these formula can be used on a par with formula of HA for breastfeeding, when the child has some diseases that require increased energy expenditure (eg, heart disease). The duration of feeding the child with these formula can reach several months if indicated. It should be remembered that despite the high level of protein breakdown in this group of formula, they can also cause allergic reactions.

Elementary formulas. Formulas of amino acids. This is a new generation of formulas. These formulas contain 100 % of broken down proteins and are especially intended for infants with suspected milk protein allergy. The point of application is severe forms of allergic dermatitis and allergic enteropathy. The main disadvantage of such formula is the high price. These babies are often fussy and seem to cry in pain, have faecal blood and / or poor weight gain. These formulas are usually not available for purchase on grocery store shelves. They do not contain intact proteins (only individual amino acids or building blocks of proteins) that can cause allergy or intolerance reactions.

High-calorie specialized formula. This group of formula is specialized and relates to enteral nutrition. These formulas are designed to feed children with diseases that require high energy expenditure (heart disease, malnutrition, bowel surgery, etc.). Caloric content of 100 ml of such formulas can reach

100-150 kcal, in contrast to standard formula (67 kcal per 100 ml) and formula of PRE (80 kcal per 100 ml).

Other adapted formula: *Follow-on formula*. Suitable from 6 months (but ask a health visitor for advice first). Follow-on formula should never be fed to babies under 6 months old. Research shows that switching to follow-on formula at 6 months has no benefits for baby. Your baby can continue to have first infant formula as their main drink until they are 1-year-old. The labels on follow-on formula can look very similar to those on first infant formula. It is important to read the label carefully to avoid making a mistake.

Growing-up milk (toddler milk). Suitable from 1 year (but ask a health visitor for advice first). Growing-up and toddler milks are marketed as an alternative to whole cows' milk for toddlers and children over 1 year old. There's no evidence to suggest that these products provide extra nutritional benefits for young children. Whole cows' milk is a suitable choice as a main drink for children from age 1. Semi-skimmed cows' milk is a suitable main drink for children over 2 who are eating a balanced diet.

COMPLEMENTARY FEEDING

The foods, given ***in addition*** to breast milk, are called ***complementary foods***. The process of feeding them is called ***complementary feeding***.

Around the age of 6 months, an infant's need for energy and nutrients starts to exceed what is provided by breast milk, and complementary foods are necessary to meet those needs. An infant of this age is also developmentally ready for other foods. This transition is referred to as complementary feeding. If complementary foods are not introduced around the age of 6 months, or if they are given inappropriately, an infant's growth may falter.

Ensuring that infants nutritional needs are met requires that complementary foods be:

- **timely** – meaning that they are introduced when the need for energy and nutrients exceeds what can be provided through exclusive breastfeeding;
- **adequate** – meaning that they provide sufficient energy, protein and micronutrients to meet a growing child's nutritional needs;
- **safe** – meaning that they are hygienically stored and prepared, and fed with clean hands using clean utensils and not bottles and teats;
- **properly fed** – meaning that they are given consistent with a child's signals of appetite and satiety, and that meal frequency and feeding are suitable for age.

Caregivers should take active care in the feeding of infants by being responsive to the child's clues for hunger and also encouraging the child to eat.

WHO recommends that infants start receiving complementary foods at 6 months of age in addition to breast milk. Initially, they should receive

complementary foods 2-3 times a day between 6-8 months and increase to 3-4 times daily between 9-11 months.

Gradually increase food consistency and variety as the infant gets older, adapting to the infant's requirements and abilities. Infants can eat pureed, mashed and semi-solid foods beginning at 6 months. By 8 months most infants can also eat "finger foods" (snacks that can be eaten by children alone).

By 12 months, most children can eat the same types of foods as consumed by the rest of the family, while keeping in mind the need for nutrient-dense foods, including animal-sourced foods like meat, poultry, fish, eggs and dairy products.

Avoid foods in a form that may cause choking, such as whole grapes or raw carrots. Avoid giving drinks with low nutrient value, such as tea, coffee and sugary soft drinks. Limit the amount of juice offered, to avoid displacing more nutrient-rich foods.

Guiding principles for complementary feeding of the breastfed child

- ✓ Practise *exclusive breastfeeding* from birth to 6 months of age, and introduce *complementary foods* at 6 months of age (180 days) while continuing to breastfeed.

- ✓ *Continue* frequent, on-demand *breastfeeding* until 2 years of age or beyond.

- ✓ Practise responsive feeding, applying the principles of psychosocial care.

- ✓ Practise *good hygiene* and proper food handling.

- ✓ Start at 6 months of age with small amounts of food and increase the quantity as the child gets older, while maintaining frequent breastfeeding.

- ✓ Gradually *increase food consistency* and variety as the infant grows older, adapting to the infant's requirements and abilities.

- ✓ *Increase the number of times* that the child is fed complementary foods as the child gets older.

- ✓ Feed a *variety of nutrient-rich* foods to ensure that all nutrient needs are met.

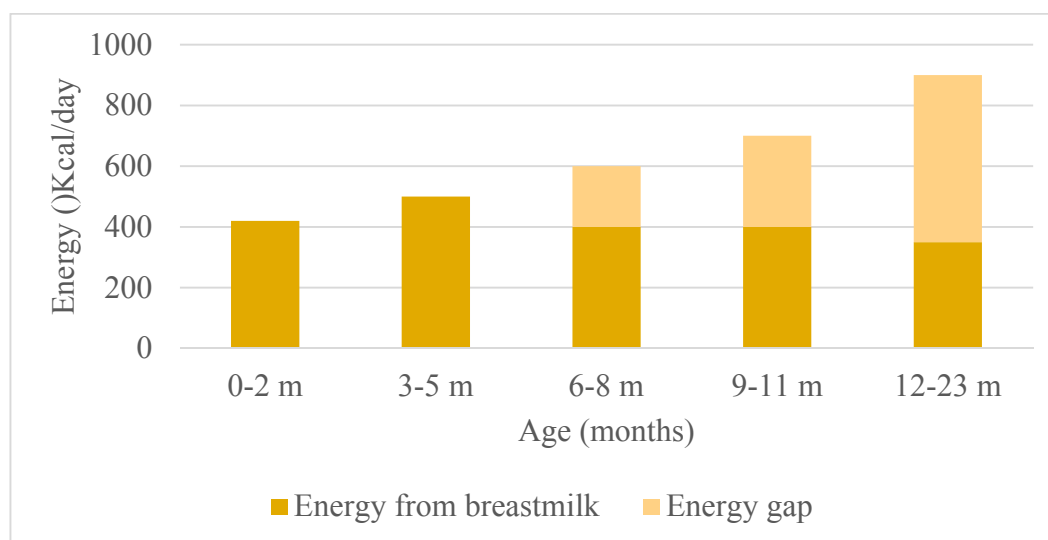
- ✓ Use fortified complementary foods or *vitamin-mineral supplements* for the infant, as needed

- ✓ *Increase fluid intake during illness*, including more frequent breastfeeding, and encourage the child to eat soft, favourite foods. After illness, give food more often than usual and encourage the child to eat more.

After 6 months of age, it becomes increasingly difficult for breastfed infants to meet their nutrient needs from human milk alone. Thus, 6 months is the recommended appropriate age at which to introduce complementary foods. During the period of complementary feeding, children are at high risk of undernutrition. Breast milk can provide one half or more of a child's energy needs between 6 and 12 months of age, and one third of energy needs and other high quality nutrients between 12 and 24 month.

Energy required by age and the amount from breast milk

The breast milk covers all needs up to 6 months, but after 6 months there is an energy gap that needs to be covered by complementary foods. The energy needed in addition to breast milk is about 200 kcal per day in infants 6-8 months, 300 kcal per day in infants 9-11 months. The amount of food required to cover the gap increases as the child gets older, and as the intake of breast milk decreases.



Complementary foods should have a greater energy density than breast milk, that is, at least 0.8 kcal per gram. The quantities of food recommended in Table 1 assume that the complementary food will contain 0.8-1.0 kcal per gram.

Table 1

Practical guidance on the quality, frequency and amount of food to offer children 6-23 months of age who are breastfed on demand

Age	Energy needed per day in addition to breast milk	Texture	Frequency	Amount of food an average child will usually eat at each meal ¹
6-8 months	200 kcal per day	Start with thick porridge, well mashed foods Continue with mashed family foods	2-3 meals per day Depending on the child's appetite, 1-2 snacks may be offered	Start with 2-3 tablespoonfuls per feed, increasing gradually to v2 of a 250 ml cup
9-11 months	300 kcal per day	Finely chopped or mashed foods, and foods that baby can pick up	3-4 meals per day Depending on the child's appetite, 1-2 snacks may be offered	V2 of a 250 ml cup/bowl
12-23 months	550 kcal per day	Family foods, chopped or mashed if necessary	3-4 meals per day Depending on the child's appetite, 1-2 snacks may be offered	To full 250 ml cup/bowl

The amounts of food included in the table are recommended when the energy density of the meals is about 0.8 to 1.0 kcal/g. If the energy density of the meals is about 0.6 kcal/g, the mother should increase the energy density of the meal (adding special foods) or increase the amount of food per meal. For example:

- for 6 to 8 months, increase gradually to two thirds cup
- for 9 to 11 months, give three quarters cup
- for 12 to 23 months, give a full cup.

The table should be adapted based on the energy content of local complementary foods. The mother or caregiver should feed the child using the principles of responsive feeding, recognizing the signs of hunger and satiety. These signs should guide the amount of food given at each meal and the need for snacks. If baby is not breastfed, give in addition: 1-2 cups of milk per day, and 1-2 extra meals per day.

Beginning at 6 months, an infant can eat pureed, mashed or semi-solid foods. By 8 months most infants can also eat finger foods. *By 12 months, most children can eat the same types of foods as consumed by the rest of the family.*

There is evidence of a «critical window» for introducing «lumpy» foods: if these are delayed beyond 10 months of age, it may increase the risk of feeding difficulties later on. Although it may save time to continue feeding semi-solid foods, for optimal child development it is important to gradually increase the solidity of food with age.

The breastfed infant 6-8 months old needs 2–3 meals a day, and a breastfed infant 9-12 months needs 3-4 meals a day. Depending on the child's appetite, 1-2 nutritious snacks may be offered. Snacks are defined as foods eaten between meals, often self-fed finger foods, which are convenient and easy to prepare. The transition from 2 to 3 meals, and from smaller to larger meals, happens gradually between those ages, depending on the child's appetite and how he or she is developing.

Good complementary foods are:

- ✓ Rich in energy, protein and micronutrients (particularly
- ✓ iron, zinc, calcium, vitamin A, vitamin C and folate);
- ✓ Not spicy or salty;
- ✓ Easy for the child to eat;
- ✓ Liked by the child;
- ✓ Locally available and affordable.

The basic ingredient of complementary foods is usually the local staple. The main ingredient of the supplement, as a rule, is the local main product. The main products are cereals (buckwheat, corn, rice, oatmeal), roots (potatoes, sweet potatoes, Jerusalem artichokes) and starchy fruits, which consist mainly of carbohydrates and provide the child with energy.

A variety of other foods should be added to the staple food every day to provide other nutrients. These include:

➤ *Foods from animals or fish* are good sources of protein, iron and zinc. Liver also provides vitamin A and folate. Egg yolk is a good source of protein and vitamin A, but not of iron. A child needs the solid part of these foods, not just the watery sauce.

➤ *Dairy products*, such as milk, cheese and yoghurt, are useful sources of calcium, protein, energy and B vitamins.

➤ *Pulses – peas, beans, lentils, peanuts, and soybeans* are good sources of protein, and some iron. Eating sources of vitamin C (for example, tomatoes, citrus and other fruits, and green leafy vegetables) at the same time helps iron absorption.

➤ *Orange-coloured fruits and vegetables* such as carrot, pumpkin, mango and papaya, and dark-green leaves such as spinach, are rich in carotene, from which vitamin A is made, and also vitamin C.

➤ *Fats and oils* are concentrated sources of energy, and of certain essential fats that children need to grow.

Fats, including oils, are important because they increase the energy density of foods, and make them taste better. Fat also helps the absorption of vitamin A and other fat-soluble vitamins. Some fats also provide essential fatty acids. Fat should comprise 30-45 % of the total energy provided by breast milk and complementary foods together.

Sugar is a concentrated source of energy, but it has no other nutrients. It can damage children's teeth, and lead to overweight and obesity. Sugar and sugary drinks, such as soda, should be avoided because they decrease the child's appetite for more nutritious foods. Tea and coffee contain compounds that can interfere with iron absorption and are not recommended for young children.

Potential allergic effects are a common reason for restrict certain foods in the diets of infants and young children. However, there are no controlled studies that show that restrictive diets have an allergy-preventing effect. Therefore, young children *can consume a variety of foods from the age of 6 months*, including cow milk (except for whole cow's milk up to 12 months), eggs (yolk and egg white), peanuts (in paste form), fish (better sea fish) and shellfish.

Breast milk: continues to provide energy and high quality nutrients up to 23 months

TODDLERS (YOUNG CHILD) FEEDING

Toddlers should receive complementary foods 3-5 times daily 12-24 months. Additional nutritious snacks should also be offered 1-2 times per day for ages 12-24 months, as desired.

Breast milk covers 1/3 of energy needs and other high-quality nutrients in a child aged 12-24 months. The energy required in addition to breast milk is about 550 kcal per day in children aged 12-23 months.

Tea and coffee contain compounds that can interfere with the absorption of iron, so they are not recommended for young children.

Babies need between 1,000 and 1,400 calories a day, depending on their age, size and level of physical activity (most are considered active). The amount of food your baby needs from each food group is based on your daily calorie needs.

In addition to choosing from each of the food groups, babies need the equivalent of 3-4 teaspoons of useful oils, such as rapeseed oil and vegetable oil.

Potential risk of suffocation at the age of 12 to 24 months. At about 12 months, babies begin to eat better and possibly even on their own. Although children can now eat most foods, some of them can still choke. The way you cook can increase the risk of suffocation. Some foods that are served raw, whole or in some form can cause suffocation. Cutting food into smaller pieces and grinding food can help prevent suffocation. Here are examples of products that are potentially dangerous because they can provoke heartburn:

Fruits / Vegetables

- carrot sticks
- Whole grapes, cherry tomatoes
- Large pieces of raw fruits or vegetables

Proteins

- Whole peanuts
- Hard meat
- Seeds
- Round slices of hot dogs or sausages
- Slices of peanut butter

Cereal products

- Popcorn
- Chips

Sweetened food

- Chewing gum
- Lollipops

Example of feeding toddlers

Product groups	Daily servings, 12-24 months	Daily servings, 24-36 months	Portion size. Examples
Grains	3, at least half of them are whole grains	5, at least half of them are whole grains	1 slice of wholemeal bread; 1 mini bagel; 1/2 cup cooked pasta, rice or cereals; 1 cup of ready-made porridge
Fruits	1	1-1/2	1 small apple; 1 cup chopped fruit or cubes; 1 large banana
Vegetables	1	1-1/2	1 cup cooked mashed or finely chopped vegetables, including beans (chickpeas, black beans, etc.)
Proteins	2	2-4	1 boiled egg; 1 ounce of cooked meat, poultry or seafood; 1 tablespoon nut oil; 1/4 cup boiled beans
Milk	2	2	1 glass of milk or yogurt; 2 ounces of processed American cheese; 1 1/2 ounces of natural cheese, such as cheddar (low fat for ages 2 and up)

For a balanced diet of children it is recommended to consider:

- ✓ *Staple foods*: provide energy, some protein (cereals only) and vitamins. Examples: cereals (rice, wheat, maize, millet, quinoa), roots (cassava, yam and potatoes) and starchy fruits (plantain and breadfruit)
- ✓ *Animal-source foods*: provide high quality protein, haem iron, zinc and vitamins. Examples: liver, red meat, chicken, fish, eggs (not good source of iron)
- ✓ *Milk products*: provide protein, energy, most vitamins (especially vitamin A and folate), calcium. Examples: milk, cheese, yogurt and curds
- ✓ *Green leafy and orange-coloured vegetables*: provide vitamins A, C, folate. Examples: spinach, broccoli, chard, carrots, pumpkins, sweet potatoes
- ✓ *Pulses*: provide protein (of medium quality), energy, iron (not well absorbed). Examples: chickpeas, lentils, cowpeas, black-eyed peas, kidney beans, lima beans
- ✓ *Oils and fats*: provide energy and essential fatty acids. Examples: oils (preferably soy or rapeseed oil), margarine, butter or lard
- ✓ *Seeds*: provide energy. Examples: groundnut paste or other nut pastes, soaked or germinated seeds such as pumpkin, sunflower, melon, sesame

Reminder!

1. Foods rich in *iron*

Liver (any type), organ meat, flesh of animals (especially red meat), flesh of birds (especially dark meat), foods fortified with iron

2. Foods rich in *Vitamin A*

Liver (any type), red palm oil, egg yolk, orange coloured fruits and vegetables, dark green vegetables

3. Foods rich in *zinc*

Liver (any type), organ meat, food prepared with blood, flesh of animals, birds and fish, shell fish, egg yolk

4. Foods rich in *calcium*

Milk or milk products, small fish with bones

5. Foods rich in *Vitamin C*

Fresh fruits, tomatoes, peppers (green, red, yellow), green leaves and vegetables.

WHO and UNICEF recommend universal supplementation with vitamin A as a priority in children aged 6–59 months in countries with a high risk of deficiency.

WHO and UNICEF recommended universal salt iodization (USI) as a safe, cost-effective and sustainable strategy to ensure sufficient intake of iodine by all individuals.

Zinc supplementation is recommended as adjunct therapy in the management of diarrhoea. Zinc (20 mg/day) should be given to all children

with diarrhoea for 10–14 days. In infants below 6 months of age, the dose of zinc should be 10 mg/day.

As a rule, fortified foods should be preferred to iron supplements for children during the complementary feeding period. In malaria-endemic areas, universal iron supplementation is not recommended.

QUESTIONS FOR SELF-CONTROL

1. List the types of milk by time of formation (stages of lactogenesis).
2. Describe the anatomy of the breast and the physiology of lactation.
3. Describe the composition of breast milk.
4. List 10 principles of breastfeeding support.
5. What types of baby formulas do you know?
6. What are the principles of prescribing baby formula?
7. What are the basic rules for the introduction of supplementary feeding?
8. What complementary food and of which consistency is given to a child at 6 months?
9. What food should be given to a child to prevent iron deficiency anemia?
10. What important complementary food do you know?

TASKS

TASK 1. A child, 2 days old, was born on 34 weeks of gestation with a body weight of 1800g. What method of feeding would you recommend?

Correct answer: exclusively breastfeeding with expressed milk in alternative ways and frequent application to the breast.

TASK 2. A child, 2 months old. Parents complain about frequent vomiting and the feeling of "a little milk" in mother's breasts. How to determine if there is enough milk?

Correct answer: If the child's body weight meets the age and individual norms (body weight gain per month of life is 500 g or more), and the number of urinations is 12 or more per day - the child receives enough breast milk.

TASK 3. A child, 4 months old, exclusively breastfeeding, physical and psycho-emotional development corresponds to age. Parents consulted a pediatrician regarding the introduction of complementary foods. Your recommendations.

Correct answer: it is necessary to acquaint parents with the WHO recommendations on exclusive breastfeeding until 6 months age. Explain the principles of child's readiness to the introduction of complementary foods and tell what consistency and what amount of food a child should receive at the age of 6-12 months. Name the main products of supplementary feeding.

TASK 4. A child, 9 months old, body weight and height correspond to the age norm. The child's parents reported that 50g of supplement is given once a day. Often the child refuses supplement. Your recommendations.

The correct answer: it is necessary to explain to parents the importance of adequate nutrition at this age and remind that a child should eat 3 servings of food per day, gradually "thickening" the consistency of food. Tell about "finger feeding" and "critical window" for the introduction of solid pieces up to 10 months. If a child does not receive adequate nutrition, he has an increased risk of iron deficiency anemia. It is recommended to pass a general blood test and hemoglobin test.

TASK 5. Parents complained that the child, 2 weeks, frequent foamy stools up to 12 times a day, frequent vomiting, sometimes a fountain. Weight loss of more than 10% during this period. The baby is exclusively breastfed. What is the action algorithm of the primary care physician?

Correct answer: It is recommended to collect an infection history and data about mother's nutrition. To send the child to the hospital's pediatric department and according to results of the questionnaire and history taking, it is recommended to change the child's food to a treatment mixture with complete protein hydrolysis or lactose-free mixture.

TESTS

1. *The main carbohydrate of breast milk is:*

- A. Lactose
- B. Sucrose
- C. Dextrose
- D. OGM (breast milk oligosaccharides).

2. *Colostrum is*

- A. The child's primary stool
- B. Small white rashes on the nose of the newborn
- C. The first milk
- D. Carbohydrate of breast milk

3. *The period of emergence of mature milk:*

- A. 1-2 days after birth
- B. 3-5 days after birth
- C. 10 days after birth
- D. 28 days after birth

4. *What is the ratio of protein in breast milk?*

- A. 70 % whey protein and 30% casein
- B. 30 % whey protein and 70% casein

- C. 60 % whey protein and 40% casein
- D. 50 % whey protein and 50% casein

5. *What protects the skin of the nipple and areola during lactation?*

- A. Nipple
- B. Montgomery's glands
- C. Areola
- D. Mother's hand during feeding

6. *What hormones directly affect breastfeeding?*

- A. Oxytocin and prolactin
- B. Prolactin and adrenaline
- C. Prolactin and vasopressin
- D. Luteinizing hormone and prolactin

7. *By purpose, children mixtures are divided into:*

- A. basic, preventive (functional), therapeutic (specialized)
- B. the first mixture, the next mixture, adapted milk
- C. home, standard
- D. based on cow's, vegetable, goat's milk

8. *Therapeutic mixtures include:*

- A. A mixture of "comfort"
- B. Sour milk mixture
- C. Hypoallergenic mixture
- D. Amino acid mixture

9. *According to the WHO recommendations, the recommended age of supplementation:*

- A. 4 months.
- B. 4-6 months.
- C. 6 months.
- D. 17 weeks

10. *Which of products is not recommended to give up to 12 months?*

- A. Fish, protein, peanut paste, liver
- B. Hard cheese, beans, pumpkin
- C. Whole milk, sugar, salt, honey
- D. Olive oil, crushed products, sweet fruit purees

Answers: 1. - A; 2. - B; 3. - B; 4. - A; 5. - B; 6. - A; 7. - A; 8. - D; 9. - C; 10. - C.

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