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Early Nutrition for a Healthy Future Generation

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Abstract

A healthy organism requires a process of continued harmonious growth and development, starting from the intrauterine life, the environment in which it belongs, the educational level and the quality of the diet, representing the determinants of health. Nutrition and nurturing during the first years of life are both crucial for life-long health and well-being. Breastfeeding represents the gold standard for infant nutrition, with short-term and long-term benefits. Besides its "ideal food" status, is an important source of comfort and safety for the baby; if breastfeeding is not possible, the milk formula that the infant receives must be according to its particularities. Inappropriate complementary foods or failure to introduce complementary foods by 6 months of age plays an important role in changing the nutritional status. Inappropriate nutrition at the beginning of life has an impact

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on health in the long term over generations. Improving nutrition during the first 1,000 critical days can prevent much of the serious and irreparable damage caused by hunger and malnutrition. On the other hand, prevention measures of childhood and adult obesity should start during this period, too**.** Adequate nutrition for adolescent girls and pregnant women is essential for growth and healthy physical and mental development of young children and for the long-term prevention of chronic diseases and premature death.

Keywords: early nutrition, the first 1,000 days, healthy development, malnutrition.

Introduction

The first 1000 days of life (from conception to 24 months) represent the most critical period, essential for the healthy development of the future adult. The nutrition in this period plays an important role in the optimal development of all organ systems and their ability to adapt to conditions in the environment. The first 1000 days are known as the "the window of opportunity" and improving nutrition during this life period can prevent much of the serious and irreparable damage caused by hunger and malnutrition.

At the moment, there is more and more discussion about the importance of *early nutrition* and its consequences for later health. The implications of *early nutrition* programming are significant – particularly when it comes to the risk of suffering cardiovascular diseases, diabetes, obesity and allergy in life. A healthy organism requires a process of continued harmonious growth and development, starting from the intrauterine life, the environment in which it belongs, the educational level and the quality of the diet, representing the determinants of health. Fetal and childhood development is characterized by rapid growth; therefore any qualitative or quantitative changes in food during this period can influence the way organs develop and their functionality. Current research is focused on permanent effects of early nutrition on physiology and function, which in turn influences the evolution of disease during their lifestyle (Robinson, 2015; Elenberg & Shaoul, 2014).

Intergenerational cycle of growth failure

In the last years, the complex causes (poverty, infections, underdevelopment, and low socioeconomic status), and mechanisms of malnutrition development have already been known. Classically, the term malnutrition, representing underweight, has changed, so at present, it includes both malnutrition and obesity, both of which

have serious consequences for health care and development. Inadequate nutrition represents "a scourge in our world" (Fanzo, 2015) and often starts in uterus and extends, especially in periods with increased nutrient requirements at specific points of the lifecycle: infant and young children, adolescent girls, and pregnant and lactating women (see *Figure 1*) (UNSCN, 2000a).

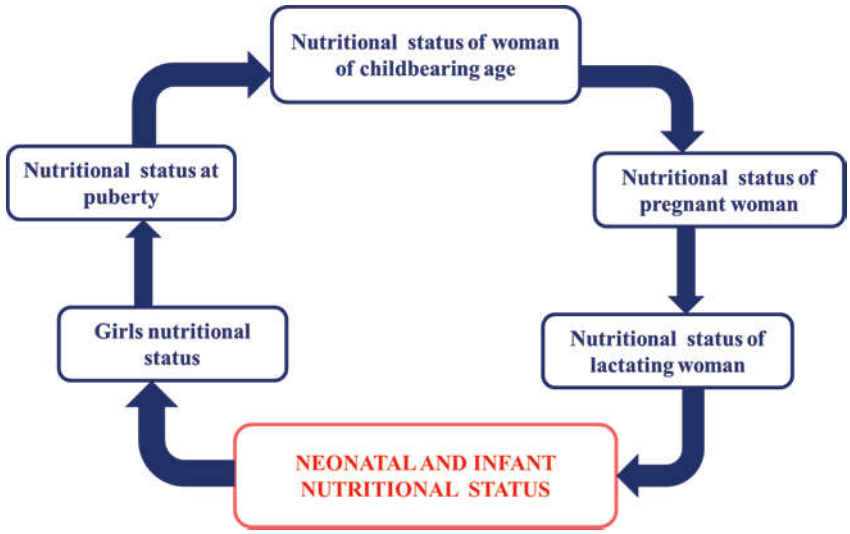

Figure 1. Poor nutrition throughout the lifecycle
(adaptation after UNSCN- Fourth Report on the World Nutrition Situation: Nutrition throughout the life cycle., 2000a)

Inappropriate nutrition at the beginning of life has an impact on health in the long term over generations. This is seen throughout the world as malnourished women gave birth to malnourished daughters who grew up to become malnourished mothers themselves, thereby perpetuating the cycle. Malnutrition is not just a problem of hunger in developing countries - it exists in all regions and across different socio-economic classes. Imbalances caused by poor nutrition in the early years of the child's life translate into a huge economic burden for countries, costing billions of dollars in lost productivity and avoidable health care costs (Food and Agriculture Organization of the United Nations, 2014). Poor nutrition that occurs during childhood, adolescence, and pregnancy has an additive negative impact on the birth weight of infants. Preventing fetal malnutrition by improving the mother's nutritional status will ensure good health and optimal nutrition for the newborn, and for long-time will prevent an entire range of chronic diseases in adulthood. Newborns with low birth weight have an increased risk of dying in the neonatal and young children period, and may suffer from growth retardation, major and subtle neurodevelopmental handicaps, and developmental origin of health and disease. The "fetal origin of the disease hypothesis" is based on the link between fetal

undernutrition and the increased risk of various adult chronic diseases (obesity, cardiovascular diseases, diabetes mellitus, dyslipidemia, etc.) (Deepak, Sweta, & Pradeep, 2016; UNSCN, 2000b). The consequences of undernourished birth extend to adulthood and affects not only individual well-being but also the social and economic development of nations (Black, Victoria, & Walker, 2013).

Most growth faltering occurs between the ages of six and 24 months, when the child is no longer protected by exclusive breastfeeding, thus being more exposed to disease and infectious diseases through contaminated food and water. Some evidence suggests that even when a child is adequately nourished after 24 months of age, he/she is unlikely to recover growth "lost" in the first two years as a result of malnutrition (Victora *et al*, 2010). Some argue that nutrition interventions should prioritize these first 1000 days of life (from conception to 24 months). Children with adequate nutrition and opportunities for early learning and responsive caregiving have the best chances of thriving. As it has already been mentioned, the first 1000 days are known "the window of opportunity" to make a difference in a child's life. Prentice and colleagues argue that the nutritional needs of adolescent girls are an "additional window of opportunity" during which substantial life cycle and intergenerational effects can be accrued (Victora *et al*, 2010; Prentice *et al*., 2013).

The vicious circle of malnutrition can be interrupted during adolescence by using proper nutrition and treatment of all deficiencies in both micro and macronutrients. The adolescence period is characterized by a rapid growth with multiple changes: physical, intellectual and psychological. Teenage girls with malnutrition continue to grow during the time of their first pregnancy, which consequently affects the fetus's growth and development. Girls younger than 19 years of age have a 50% increased risk of stillbirths and neonatal deaths, as well as an increased risk for preterm birth, LBW, and asphyxia. These health risks further increase for girls who become pregnant earlier than 15 years of age and are somewhat reduced for older adolescents aged 18-19 years. Nutrition in pregnant teens is crucial, since their bodies are not physically ready for pregnancy and they tend to give low priority to nutrition despite having enhanced needs for nutrients owing to their pregnant state (Das *et al*., 2017). Nutrition in adolescence will improve the health of women and future generations of children. Thus, the development of National Health Programs for adolescent health care can contribute to break the malnutrition cycle. Adequate nutrition for adolescent girls and pregnant women is essential for growth and healthy physical and mental development of young and for the long-term prevention of chronic diseases and premature death. So, the consequences of undernourished birth extend to adulthood.

The baby-friendly hospital initiative

The first few hours and days of a newborn's life are a critical window for establishing lactation and for providing mothers with the support they need to breastfeed successfully. In 1991, World Health Organization (WHO) and UNICEF launched the "Baby-friendly Hospital Initiative" (BFHI), based on "Ten Steps for Successful Breastfeeding" (The Ten Steps) which is aimed at ensuring the protection, promotion and support for breastfeeding in maternity facilities (WHO & United Nations Children's Fund, 1999). Why has the need for hospitals and maternities which are baby friendly arise? Because it is very important to support and provide real help to mothers when it comes breastfeeding, information on short and long-term benefits, both for the child, the mother and the whole family.

The BFHI has been implemented in almost all countries in the world, with varying degrees of success. After more than a quarter of a century, coverage at a global level remains low. As of 2017, only 10% of infants in the world were born in a facility currently designated as "Baby-friendly" (WHO, 2017 a). In Romania, there are hospitals designated as Baby-Friendly Hospital. In the case of countries where BFHI has not been implemented in order for the mother-to-child couple to benefit from the optimal start in life, it is recommended to focus on integrating and institutionalizing the ten steps, improving the quality of the installation approach, and solid political environment, support and monitoring and accountability mechanisms. In the case of countries where BFHI has not been implemented in order to help the mother-to-child couple to benefit from the optimal start in life, it is recommended to focus on integrating and institutionalizing the ten steps, improving the quality of the installation approach, and solid political environment, support and monitoring and accountability mechanisms (WHO, 2018a).

The Ten Steps summarize a package of policies and procedures that improve the provision of maternity and newborn services which should be implemented to support breastfeeding. A systematic review on maternity and newborn care published in 2016 clearly demonstrated that adherence to the Ten Steps impacts early initiation of breastfeeding and improves the rate and adherence to breastfeeding (WHO, 2018b).

Breastfeeding: the gold standard for infant nutrition

Breastfeeding represents the gold standard for infant nutrition, with short-term and long-term benefits and besides its "ideal food" status, is an important source of comfort and safety for the baby. It is recommended for all children except for a few medical conditions, such as maternal medication with radioactive substances (Victora *et al*., 2016). The decision to breastfeed is a personal matter. It is also one that is most likely to draw strong opinions from friends and family. Breastfeeding

is the normal way of providing young infants with the nutrients they need for their healthy growth and development. Virtually all mothers can breastfeed, provided they have accurate information, and the support of their family, the health care system and society at large.

The WHO currently recommends exclusive breastfeeding up to 6 months of age (no formula, juice, or water), followed by complementary feeding in parallel to breastfeeding, up to 2 years. But the mother and her baby are unique, and the decision is up to her. Promoting breastfeeding is a priority component of all programs aimed at respecting the child's right to health, living in a healthy environment and normal development. Colostrum, the yellowish, sticky breast milk produced at the end of pregnancy, is recommended by WHO as the perfect food for the newborn, and feeding should be initiated within the first hour after birth, the "magic hour" (WHO, 2018c).

The mother needs to know that she is able to give the child all the nutrients necessary for healthy growth and that breast milk influences the child's health in the long run. At the same time, breastfeeding is the connection that emotionally approaches them. This milk has a nearly perfect mix of vitamins, protein, and fat – everything required for normal growth. The composition of human milk has been studied more and more thoroughly in recent years and the unanimous conclusion was that it represents the best food, both for babies born in term, but also for premature or low birth weight babies. Numerous studies have shown the importance of proteins, both qualitatively and quantitatively, human milk containing the appropriate amount and quality, and the role of gut microbiota in infants' health.

The type of feeding is one of the key factors influencing gut microbiota composition and development of infants. Evidence suggests that breastfeeding infants have a higher abundance of beneficial bifidobacteria than infants fed with a typical infant formula (Collado *et al*., 2012). Besides the known notions about micro and macronutrients in human milk, over the last few years, there has been more and more discussion about the importance of oligosaccharides (the third largest component of breast milk, after lactose and lipids, now recognized as components that play an important role in the maturation of the immune system of babies and not only) (Bode, 2015).

Human milk contains antibodies that reduce morbidity, mortality and hospital admissions, trips to the doctor related to diarrhea and respiratory tract infections. Breastfeeding reduces the risk of asthma and atopic dermatitis in children who have a hereditary risk of allergies, reduces the risk of becoming overweight or obese in childhood and adolescence, decreases the risk of diabetes and certain cancers as well, but more research is needed. Specialists have found that breastfeeding improves and favors the development of IQ (intelligence coefficient) in over 90% of babies. Another important observation is that breastfed infants have a much

lower risk of sudden infant death syndrome (Dieterich *et al*., 2013; WHO, 2013a; WHO, 2013b).

According to data published by UNICEF (*Figure 2*), the exclusive breastfeeding rate of infants 0-5 months of age between 2013 and 2018 differs significantly by country and region (UNICEF, 2018).

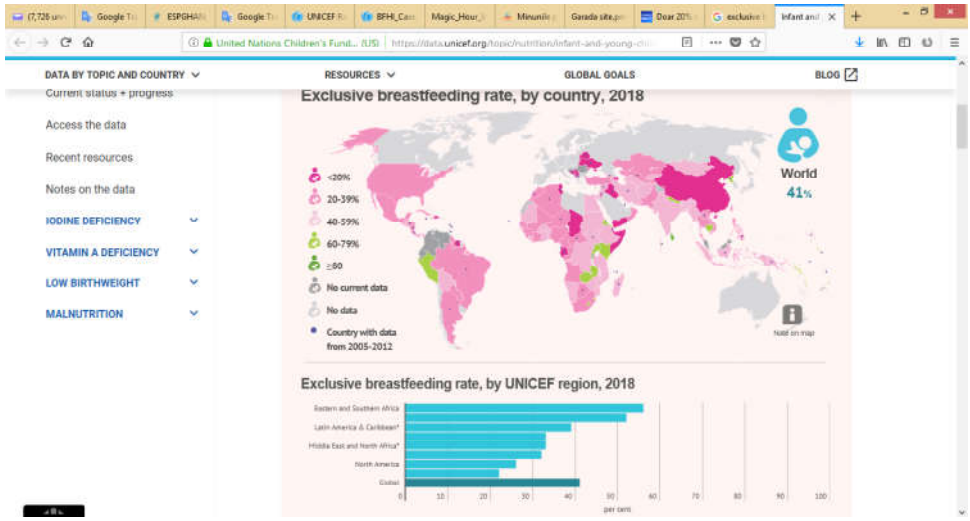

Figure 2. Per cent of infants 0–5 months of age exclusively breastfed, by country and region, 2018 *(Source: UNICEF global databases, 2018)*

According to data presented by a national television station in April 2017, in Romania, only 20% of mothers breastfeed their children during the first 6 months of life. The main reason for this harmful phenomenon is the lack of accurate information, the contradictory counseling and the lack of maternity specialists (Pro TV, 2017). The same television station presented in 2016 the worrying figures of a national survey, which discovered that only one third of mothers in Romania breastfeeding babies for more than 6 months (Pro TV, 2016).

World Breastfeeding Week runs from August 1 to August 7. On this occasion, a mobile application, "Breastfeeding Laborer", with specialized information in Romanian was launched for current mothers as well as for pregnant women, according to a press release from the "Milk Love Association" which launched the application (Adevarul, 2018).

There are a lot of situations when milk from the infant's own mother is not available or sufficient. Human milk banks play an essential role for infants with health problems, who are deprived of human milk, and implicitly of all its benefits, to get a chance at a healthy diet. Premature infants represent the largest and most sensitive category of children who benefit. Worldwide, there is a growing interest in expanding coverage with human milk banks (Haiden & Ziegler, 2016).

What is so magical about the "magic hour"?

The first hour of life is an unique, distinct development period for the human being with physical and psychological advantages in the short and long term. It has been a common practice since ancient times, and so it is still the case in cultures where birth is not done medically. During the first hour of life, a healthy child shows a high level of vigilance and the ability to interact with their parents. The child recognizes the voices and the smell of the parents. According to neuro-scientific research done on mammals, this intimate contact is inherent to the basic needs of the newborn - heat, food, protection. Direct skin contact helps the child to: better regulate body temperature, stabilize heart rate, stabilize breathing rate, reduce blood pressure and pain perception, reduce stress and improve brain development. It is a good time to create the attachment between mother and baby (Moore *et al*., 2016).

What shall we do when breastfeeding is not possible?

In case the child does not benefit from human milk (the mother chooses not to breastfeed or if she has a medical condition contraindicating breastfeeding), milk formula will be used, always adapted individually, according to the baby's particularities, taking into account the medical, family and personal history. Milk formulas provide the qualitative and quantitative needs appropriate to each stage of development and age, while respecting European standards (European Food Safety Authority, 2014).

In a situation where the mother cannot breastfeed with all the necessary supervision and medical advice, it is vital that the baby is fed with highly scientifically proven breast milk substitutes to help them develop normally. The International Code of Marketing of Breastmilk Substitutes (the Code) is an international health policy framework to regulate the marketing of breastmilk substitutes in order to protect breastfeeding. It was published by the World Health Organisation in 1981 and it represents an internationally agreed upon voluntary code of practice. The Code regulates the marketing of breastmilk substitutes which includes infant formulas, follow-on formulas and any other food or drink, together with feeding bottles and teats, intended for babies and young children. The Code also sets standards for the labelling and quality of products and for how the law should be implemented and monitored within countries (WHO, 1981).

The Code, aims to contribute "to the provision of safe and adequate nutrition for infants, by the protection and promotion of breastfeeding, and by ensuring the proper use of breast-milk substitutes, when these are necessary, on the basis of adequate information and through appropriate marketing and distribution" (WHO, 2017b). Protecting the health of children and their mothers from continued misleading marketing practices should be seen by countries as a public health

priority and human rights obligation (WHO, UNICEF & IBFAN, 2018). The obesity prevention policies recommend using the infant formula containing less protein than previously used (Koletzko *et al.*, 2017).

Complementary feeding: the perfect time for introducing new foods - foundation of good health

From birth, breastmilk or milk formula meets all the baby's needs for food and drink to help them grow and develop. By about 6 months they will begin to need more iron and nutrients than milk alone can provide. The complementary feeding (CF) period is one of rapid growth and development when infants are susceptible to nutrient deficiencies and excesses. Complementary foods (solids and liquids other than breast milk or infant formula) should not be introduced before 4 months old but should not be delayed beyond 6 months old (Fewtrell *et al.,* 2017). Infants who are introduced to solid foods before this time may be prone to excessive caloric intake, food allergies, and gastro-intestinal upset (Cattaneo *et al*., 2011).

Complementary foods should be introduced to meet these nutrient gaps. It is the time when malnutrition begins to develop in many infants, contributing significantly to the high prevalence of malnutrition in children under five years of age world-wide. WHO recommends that infants start receiving complementary foods at 6 months of age in addition to breast milk, initially 2-3 times a day between 6-8 months, increasing to 3-4 times daily between 9-11 months and 12-24 months with additional nutritious snacks offered 1-2 times per day, as desired (WHO, 2018 c).

Inappropriate complementary foods or failure to introduce complementary foods by 6 months of age plays an important role in changing the nutritional status. In this period, children explore different tastes and develop food preferences. We must not forget that the genetic innate predisposition is to enjoy the sweet and salty taste and the rejection of the sour and bitter taste. The early flavour experiences and food preferences of infancy track into childhood and adolescence. That is the reason why complementary feeding represents an important phase to establish future health eating habits (Agostoni *et al*., 2008).

A special place is occupied by proteins. Quantity and quality of protein consumed during complementary feeding may affect developing tissues, what leads to a higher risk for development of non-communicable disease in adulthood, such as metabolic syndrome and coronary heart disease (Langley-Evans, 2015). It is currently known that high protein intake during the first 2 years of life may induce higher growth rate and increases the risk of overweight and obesity in later life (Michaelsen & Greer, 2014).

Particularly care is required to ensure an adequate nutrient intake during complementary feeding when vegetarian or vegan diets are used. If a parent chooses to wean an infant onto a vegan diet this should be done only under appropriate medical or dietetic supervision (Van Winckel *et al.,* 2011). In order to prevent deficiencies in vegetarians, there are strategies, and the conclusion is that a well-planned vegetarian diet is adequate for infant, children, and adolescents (McEvoy & Woodside, 2015).

In 2017, European Society for Pediatric Gastroenterology, Hepatology, and Nutrition published a position paper regarding complementary feeding, according to which there are clear recommendations regarding the moment of initiation of complementary nutrition, the use of cow milk, the introduction of potentially allergenic foods, gluten, the use of iron-enriched foods and vegan diets, all this to ensure a harmonious development and a healthy future. In Romania, an important aspect of ensuring healthy development is the prophylactic administration of vitamin D and iron in well-defined children categories, according to the protocols published by the Romanian Pediatric Society (2013).

Nutrition in adolescent and pregnancy - "the future key" to break the vicious cycle of intergenerational malnutrition and chronic diseases during adulthood

The high rate of growth during puberty and adolescence is second to that in infancy, but is greater in duration, and therefore total nutritional requirements during puberty may be greater than during any other period in life. Nutrition and the adolescent transition are closely intertwined, since eating patterns and behaviors are influenced by many factors, including peer influences, parental modelling, food availability, food preferences, cost, convenience, personal and cultural beliefs, mass media, and body image (Das *et al.*, 2017). Besides nutritional programs focused on children and young women, it is important to develop national strategies on adolescent nutrition, thus allowing to break the vicious cycle of intergenerational malnutrition, chronic diseases and poverty (WHO, 2006). Nutritional interventions in adolescence offers time to optimize health in the years ahead, including the health of women during future pregnancies and also the related health of the next generation (Das *et al.*, 2017*).* Thus, the development of National Health Programs for adolescent health care can significantly contribute to breaking the malnutrition cycle.

In 2016, WHO recommend pregnant women, in the context of routine antenatal care, a healthy eating patterns and remaining physically active during pregnancy, in order to prevent excessive weight gain during pregnancy (WHO, 2016). A healthy pregnancy should include consuming varied food, having regular meals, maintaining a normal body weight taking into account the BMI at the beginning

of pregnancy (e.g for a normal BMI between 18,5-24,9 kg/m2, the weight gain during the entire pregnancy is 11,5-16 kg), reducing intake of products containing caffeine, limiting the intake of candy, snacks, sweetened beverages and artificial sweeteners as well as salt (Ministry of Health, State of Israel, 2018).

WHO recommended daily oral iron supplementation to prevent maternal anaemia, puerperal sepsis, low birth weight, preterm birth and folic acid supplementation. This supplementation should be commenced as soon as possible, ideally before conception, to prevent neurological malformation (WHO, 2016).

Conclusions

In conclusion, there is growing evidence that eating is one of the environmental factors which influences the incidence of various diseases. Epidemiological evidence from both the developed and developing countries indicates that there is a link between fetal under-nutrition and increased risk of various chronic diseases during adulthood. The effect begins in the prenatal stage to the epigenetic level, continues during pregnancy, when the mother's nutrition affects the fetus, and then during the early stage of life, where breastfeeding is the key element. Prevention measures of childhood and adult obesity should start during the first 1000 days of life. Unfavorable fetal programming can be prevented by weight management/ lifestyle change programs dedicated to young women before and during pregnancy. Children are the future, and ensuring their healthy growth and development should be a major concern. Every age has its peculiarities and it is absolutely necessary to develop national programs for adolescent health in order to ensure the health of future generations.

Acknowledgments

All authors contributed equally to this paper.

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