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Use of Vitamin D in Children with Atopic Conditions

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Abstract: Atopic condition is a global problem of the 21st century as the number of children suffering from this disease is steadily increasing. Around the world, about 20% of the population seek medical help with clinical manifestations of this disease. In addressing public health issues, interest has increased in the incidence of vitamin D deficiency, its role in the pathogenesis of various diseases, as well as in ways to correct vitamin D deficiency. Vitamin D is involved not only in the metabolism of calcium and phosphates and has become a factor in ensuring the most important physiological functions. It has become a steroid hormone with endocrine, para- and autocrine effects. The predictive role of vitamin D in the development of autoimmune, cardiovascular pathologies, metabolic syndrome and its association with a high risk of mortality have been established. Vitamin D deficiency has become a global health problem in all countries of the world, especially in children's health.

Key words: Vitamin D deficiency, total IgE, bronchial asthma, atopic dermatitis, children, dose, prevention.

In recent years, the incidence of atopic dermatitis has increased significantly, and currently its prevalence averages 10-20%. The disease is more common in children and usually appears before the age of 1 year. According to statistics, boys get sick 2 times more often than girls. In this regard, the issues of predicting this pathology, identifying the causes and triggers of exacerbation of atopic dermatitis for carrying out preventive measures and improving the quality of life of young patients and their parents' importance. Atopic dermatitis develops in early childhood and is the initial stage of the “atopic march”, so in more than 60% of cases the onset of the disease occurred before the age of two, in 80% of cases before the age of five. The well-being of children has a special medical and social significance, determining the present and future health of the population. The formation of children's health is influenced by a large number of factors, in particular the individual characteristics of the body and climatic conditions [1]. Under the influence of environmental factors on the human body, not only an adaptive function is formed, but also negative changes occur in the child’s body. The impact of environmental factors entails a load on the activity of all systems and organs, causing nonspecific responses expressed in systemic disorders, an increase in general and nosological morbidity. Acute respiratory diseases are the most common pathology of childhood. The mucous membrane of the upper respiratory tract (URT) represents the body's first line of defense against a variety of pathogenic environmental factors, such as viral, bacterial, fungal infections, chemical and physical (cooling, overheating) irritants and pollution [1]. In addition, the anatomical and physiological features of the gastrointestinal tract (GIT), morphological, functional immaturity of the regulatory mechanisms of the sphincter apparatus, imperfect motor skills, violations of the feeding regime and technique in young children are the cause of regurgitation [2, 6] and can interfere with the age-related formation of the microbiome upper respiratory tract. Repeated or recurrent respiratory infections are often observed in children with an allergic predisposition, which subsequently leads to a high risk of developing bronchial asthma (BA) [1, 2]. In the last decade, vitamin D has once again begun to attract the attention of many researchers. In the scientific literature, its deficiency -

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hypovitaminosis in all age groups, most pronounced in childhood, is presented as a global problem of our time and a pandemic inherent in all nations and peoples of the Earth [4]. There is a lot of information that more than half of the world's population is deficient in vitamin D [5], and its optimal level in the blood serum should not be lower than 20 ng/ml (normal range is 30-120 ng/ml) [6]. The main reasons for the difficulty of monitoring infectious diseases in unstable children are age-related characteristics of the immune system, unfavorable environmental factors, persistent viral infections, which subsequently cause the development of allergic diseases, primarily bronchial asthma [3]. Over the past decade, vitamin D and its active forms have been considered in the context of a possible effect on the incidence of respiratory infections in children through the regulation of the synthesis of antimicrobial peptides. Analysis of the level of vitamin D in people at risk of developing allergic diseases and children who have developed asthma will make it possible to clarify its role in the development of an allergic background.

Allergic diseases (atopy) constitute a genetically heterogeneous group of chronic immune-associated pathologies [1]. Increases in their frequency in children are associated with maternal health and its background [2]. Food allergies still make up a significant proportion in the structure of allergic diseases [3]. These conditions themselves contribute to the development of acute respiratory infections, repetition and relapse. The role of vitamin D in calcium homeostasis and metabolism has been well studied [12], and evidence of its involvement in the modulation of the immune response and airway inflammation is rapidly growing [13, 14]. A large number of scientific studies indicate an association between widespread vitamin D deficiency and atopy in children [15–17]. There is an opinion that denies this connection [18], which is supported by the lack of established data on the optimal levels of vitamin D in the blood serum of children and the necessary doses to replenish it [19]. Vitamin D (calciferols) is a general name for two related fat-soluble compounds – ergocalciferol and cholecalciferol, which can accumulate in the body with extremely adverse consequences [20].

Vitamin D (calciferols) is a general name for two related fat-soluble compounds - ergocalciferol and cholecalciferol, which can accumulate in the body with extremely adverse consequences and complications [20]. Ergocalciferol (vitamin D2) can only be supplied to a child’s body through food of plant origin; cholecalciferol (vitamin D3) is synthesized in the human body by the epidermal layer of skin under the influence of ultraviolet rays [21]. In this regard, children with atopy are recommended to replenish their supply of vitamin D for longer periods of time in the sun in the morning, since this vitamin is synthesized early in the morning [22]. Vitamin D enters the body in an inactive form and due to two-stage metabolism in the liver, and then in the kidneys it is converted into an active hormonal form - calcitriol, which inhibits the transformation in the kidneys as its concentration in the blood increases [23]. Calcitriol, in combination with a carrier protein, is transported into cells, where it interacts with intracellular receptors and changes the rate of translation of various proteins. Another reason considered to be among the reasons for the widespread occurrence of vitamin D deficiency is changes in the liver such as cholestasis [25]. Severe hypovitaminosis D is observed in children with obesity, metabolic syndrome, and excess weight, especially when combined with atopy, bronchial asthma, and hepatic steatosis [26–28]. These conditions further contribute to the development of frequently ill children.

A significant number of scientific works are devoted to the study of vitamin D levels in pregnant women as a starting point for protecting the child from atopy. There is a connection between hypovitaminosis D in a pregnant woman and an increased risk of developing allergic diseases in the child: bronchial asthma, atopic dermatitis and their combination. The researchers found that children's protection from atopy for 10 years of their life was provided by their mothers' vitamin D levels during pregnancy.Maternal hypovitaminosis D is a risk factor for the development of atopy in the child, along with a genetic predisposition to it. Less pronounced vitamin D deficiency was observed in children who were breastfed for more than 6 months, which significantly reduces the risk of atopy in such infants over the course of 3 years of their life.

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A number of scientific papers are devoted to the study of vitamin D in children with food allergies. The dependence of exacerbations of the disease on vitamin D deficiency, including food allergies without an increase in the level of total IgE, has been established. This is interpreted as a lack of vitamin D intake from food. There is a dependence of exacerbations of seasonal allergic rhinitis and atopic dermatitis on vitamin D deficiency. The highest levels of total IgE are associated with very low levels of vitamin D in serum. Most scientific works have obtained positive results of the effect of vitamin D preparations on the immune response of the child's body. The immunomodulatory effects of vitamin D have been established, normalizing the Th1/Th2 ratio. Many scientific works indicate the positive effects of vitamin D preparations in the treatment of bronchial asthma, shortening and alleviating its attacks. A positive effect of vitamin D on the results of allergen-specific immunotherapy in children with bronchial asthma has been established. Vitamin D is being intensively studied in infectious diseases, including in children, due to its participation in the production of antimicrobial peptides, which provide direct antimicrobial effects and are key components of innate immunity.

In cities, vitamin D deficiency in children is more pronounced [7] than in rural areas [8]. Seasonal differences in the use of vitamin D in practical medicine have been determined.The highest dosages of its replenishment are recommended to be prescribed in the winter season with their reduction in the summer [10]. Currently, there is no consensus on the optimal levels of vitamin D for the full functioning of the child's body, which necessitates further study of the problem [11]. The World Health Organization, the UN Environment Program and the World Meteorological Organization at one time developed such an indicator as the ultraviolet index (UV index), reflecting the degree of ultraviolet radiation. The UV index takes values from zero and above). The higher the UV index value, the higher the potential hazard to human skin and eyes and the shorter the time required to cause harm to health, which can also limit the amount of time exposure to sunlight on the skin due to the risk-benefit ratio. Excessive exposure to UV rays can cause acute and chronic effects on the health of the skin, eyes and immune system, but small doses of UV rays are vital for the body's production of vitamin D.

Considering all of the above, in Uzbekistan in 2018, a national program was adopted to correct vitamin D deficiency in children in accordance with age. According to the program, the following preventive doses are established: 0–1 month. – 500 IU per day; 1–12 months – 1000 IU per day; 1–3 years – 1500 IU per day; 3–18 years –1000 IU per day. The prophylactic doses indicated above apply to healthy children, but it is necessary to take into account children from risk groups, for example, premature and low birth weight children, those with overweight or obesity, those with already manifested clinical signs of rickets, those with chronic liver and kidney diseases, etc. In addition, the region in which the child lives matters. There are also direct risk factors for vitamin D deficiency in children that can be prevented even before the development of this condition: reduced solar insolation, reduced skin synthesis of vitamin D, insufficient intake of vitamin from diet, the presence of chronic concomitant pathology, the need to take certain medications [9].

Thus, the effects of vitamin D are divided into classical and non-classical. The first group of effects is aimed at maintaining phosphorus-calcium metabolism in the plasma at the proper level, which is necessary for the processes of bone mineralization. The role of calcitriol in bone homeostasis is to activate the intestinal absorption of calcium and phosphorus: only 10–15% of Ca and 60% of phosphates from food are absorbed in the intestine without the participation of 1,25(OH)2D3 [12]; influence on the metabolism of calcium and phosphorus; induction of differentiation and proliferation of chondrocytes and osteoblasts, as well as the production of osteocalcin, a non-collagenous bone protein; regulation of skeletal growth in length and width; differentiation of connective tissue cells. The second group of effects of vitamin D are non-classical. The effect on the immune system is quite diverse and multifaceted, since almost all cell types express VDR, and some of them can even synthesize 1,25(OH)2D3.

Therefore, an insufficient amount of vitamin D in the blood can contribute to a more frequent incidence of acute respiratory viral infections, the development of autoimmune diseases, and more. Thanks to ongoing research around the world, there is no doubt about the role of vitamin D insufficiency/deficiency in the pathogenesis of various diseases, including autoimmune diseases. In addition, a relationship has been established between vitamin D levels and disease severity in many cases. However, to date, the effect of restoring adequate vitamin D levels on the course of diseases is not yet fully known. It is also necessary to determine the dosage of drugs when replenishing vitamin D insufficiency/deficiency in patients. The protective effects of vitamin D are most pronounced when taken daily or weekly in all age groups, and adverse events with vitamin D are extremely rare. In this regard, optimization of preventive programs to compensate for vitamin D insufficiency and deficiency in children is a promising direction. The use of vitamin D in the prevention and complex therapy of respiratory diseases and atopic conditions will reduce the incidence of complications and adverse outcomes. Answers to the above questions will allow us to improve both treatment methods and disease prevention, which will undoubtedly improve the quality of life of patients.

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