Micronutrient Bridge in Infectious Diseases and Its Immunological Role

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ABSTRACT

Nutrition plays an important role in child health. Nutrition is an exogenous factor which plays a vital role in metabolism and growth. Micronutrients are the nutrients, which help promote the immunological function and help in maturation and proliferation of T-cells and B-cells. Here, we review the role of micronutrients in infectious diseases and their essentiality towards the concept of immunology.

Keywords: Nutrition, micronutrients, immunity, immunology

Nutrition plays an important role in child health. Nutrition is an exogenous factor which plays a vital role in metabolism and growth. Micronutrients are the nutrients which help promote the immunological function and help in maturation and proliferation of T-cells and B-cells. There are certain micronutrients, like iron, folic acid, vitamin A and vitamin B complex, copper and selenium that help in the maturation of T-cells and B-cells, which, in turn, increases the antibody response to fight against infections. The risk of common diseases and death is due to deficiency and depletions of micronutrients in the diet. So, each and every micronutrient has recommended dietary allowances (RDA) per weight in kilogram which is standardized by the World Health Organization (WHO). The appropriate RDA value of micronutrients should be given to the child to increase the immunity and phagocytic activity. According to the UNICEF, micronutrients are the nutrients which are not only responsible for physical growth and immune cell function but they also cater to the hormonal metabolism, biochemical mediators and sexual maturation. Micronutrient deficiency can cause serious health problems, such as reduced resistance to infectious diseases that can lead to death and mental retardation. Children with subclinical deficiencies of micronutrients and under nutrition are prone to day-to-day infections, leading to death. This paper reviews the role of micronutrients in infectious diseases and their essentiality towards the concept of immunology.

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ROLE OF MICRONUTRIENTS IN IMMUNE RESPONSES

Iron

Iron is the one of major micronutrients which plays a vital role in the human body for oxidation-reduction reactions. It is a component of oxygen carrying compounds hemoglobin and myoglobin. Iron deficiency serves as a cause of threatened infectious diseases. If iron deficiency is not corrected, it leads to anemia. More than 2 billion people are affected with iron deficiency. Iron deficiency anemia is common in the following situations:

- Social disadvantages such as poverty, poor housing and lower level of parental education
- Psychological disadvantage - It is due to insufficiency of iron and heme concentration in the blood, which leads to neurological lack of stimulation
- Biological disadvantage - There are certain situations where the biological disease leads to low birth weight, high infection rates and other nutritional deficiencies.

Iron deficiency is known to alter the emotional state of infants. Iron and folic acid can be obtained by consuming green leafy vegetables. Traditional food practices such as fermentation can improve the availability of iron in the diet. Deworming and breastfeeding will decrease iron deficiency anemia. Environmental sanitation plays a vital role in reducing the risk of infection.

Iron plays a vital role in the T-cell development which also generates some reactive oxygen and free radicals to kill the pathogens. The recommended supplementation of iron is 7-8 mg daily to overcome infections and leads to exaggerated immunity.

Zinc

Zinc is a vital nutrient. Zinc plays a key role in human metabolism and perpetuation of genetic materials for the enhancement of central dogma of molecular biology, which includes translation of ribonucleic acid (RNA) and transcription of proteins. The major source of zinc is through diet to enhance the immune function of the human body. Zinc is an important constituent of metalloenzymes and plays an important role in the synthesis of deoxyribonucleic acid (DNA) and RNA.

Zinc acts as a cofactor and enhancer for cell replication and intestinal mucosal cells regeneration. It is essential for wound healing and for epithelial cells turnover to maintain healthy skin. Zinc deficient children are prone to infections and cellular tissue damage. Zinc deficiency leads to regression of gene expression, alters the immunity level in the host, alters maturation and gonads development and pregnacy outcomes. Diarrhea is associated with increased amount of zinc excreted in feces. Dietary deficiency is common since the bioavailability of zinc is reduced by the co-existence of fiber and phytate in foods of vegetable origin. Zinc is an enhancer of T-cell production and subtypes switch. It stimulates the complement system leading to enhancement of both pathways of complement activation. Zinc plays a role in phagocytosis which leads to reduction in the risk of pneumonia, common cold symptoms and reduction in infectious diseases.

Selenium

Selenium is a mineral for the stimulation of antibodies. It is an antioxidant mineral. Selenium is incorporated into protein to make selenoproteins. These are important antioxidant enzymes called glutathione peroxidase. Antioxidants like vitamin C and E help to prevent cardiovascular disease, age-related disease, skin aging, ocular illness and cancer. Selenium is a good immune stimulant for several viral infections. Deficiency of selenium leads to loss of antioxidant host defense and decreased function of white blood cells and natural killer cell function.

Vitamin A

The deficiency of vitamin A leads to the development of impaired resistance to infection and diminished function of innate immunity along with loss of B- and T-cells.

Vitamin B Complex

Vitamin B1, otherwise called as thiamine, and vitamin B2, aid in antibody response. Vitamin B3 (niacin) and B5 (pantothenic acid) play a vital role in the production and release of antibodies. Pyridoxine helps in T- and B-cell production and maturation whereas biotin and folic acid help in the production and maturation of T-cells, which mediate the humoral immune response of the body. Cyanocobalamin increases the production and promotion of NK-cell activity and aids in T- and B-cell production.

Vitamin C

Vitamin C is an antioxidant which protects the cells from redox stress to control the infection. It has an antiviral activity which aids in the symptoms of common cold. Vitamin C improves innate and adaptive immune function. Vitamin C leads to collagen synthesis and it tends to help in the increase of free radical production.

Vitamin D

Vitamin D plays a vital role in the phagocytic activity, and inflammatory responses, which are promoted by specific T-cell subtypes. It is also important in wound healing process.

Vitamin E

Vitamin E deficiency - Immune issues: loss of phagocytic response and B-cell dysfunction. Vitamin E deficiency causes difficulty in controlling viral infection.

CONCLUSION

Micronutrients are very important for the growth and metabolism in child health and increase the immune function against infectious diseases. Each and every micronutrient should be supplemented by RDA and WHO guidelines. Nutrients supplementation improves the physical and immunological growth in children and adults. Healthy children ensure the optimal resource development of a country.

SUGGESTED READING

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Make sure

DURING MEDICAL PRACTICE

SITUATION: A patient with type 2 diabetes and hypertension on amlodipine came for review of severe albuminuria >1 g/24 hours. He was asked to continue on amlodipine.

LESSON: Make sure to remember that telmisartan effectively and safely reduces BP and causes regression of proteinuria in both diabetic and nondiabetic, hypertensive, proteinuric patients with CKD, even in those with mild-to-moderate chronic renal failure.

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- Allergic Cough
- Cough with RTI
- Smoker's Cough
- Cough with Bronchial Asthma and Bronchitis
- Drug Induced Cough
- Cough with LPRD/GERD*

Free From Cough Discomfort

In Dry and Allergic Cough

Grilinctus® Syrup

(Dextromethorphan HBr 5 mg, Chlorpheniramine Maleate 2.5 mg, Guaifenesin 50 mg and NH_4Cl 60 mg/ 5 ml)

Grilinctus®-L Syrup

(Levocloperastine Fendizoate Eq. to Levocloperastine HCl 20 mg /5ml)

In Productive Cough

Grilinctus®-BM Syrup

(Terbutaline Sulphate - 2.5 mg and Bromhexine HCL - 8 mg/5ml)

Grilinctus®-LS Syrup

(Levosalbutamol 1 mg + Ambroxol Hydrochloride 30 mg + Guaiphenesin 50 mg / 5ml)

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*Laryngopharyngeal/ Gastro-oesophageal reflux Disease
RTI : Respiratory Tract Infection

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