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Impact of Nutrition on Immunity of Humans

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ABSTRACT

In the modern era, when the world is facing deadliest epidemics and pandemics, human body's robust and strong immune system is the first line of defense against all foreign invaders like fungi, viruses, bacteria and other pathogens. It is mandatory to maintain good nutritional status to fight against pandemic of COVID-19 and other infectious diseases. When human's age, the severity and risk of infections differ due to immune competence according to how the immune system matures, develops and declines. There are various factors which influence the immune system and its competence, including nutrition. An appropriate and adequate nutrition can instigate prompt anti-inflammatory response whenever it is essentially required by our body. In order to avoid any chronic inflammation and pathogenic microbe challenges, effective immune system is the key to success. For the maintenance of adaptive and innate immunity across the lifecycle, nutrition plays a pivotal role. Antioxidants like vitamin C, vitamin E, lycopene, lutein, carotenoids, zeaxanthin and selenium, play important roles as immunity boosters. Likewise, vitamin A, vitamin D, omega 3 fatty acids and phytochemicals from food also have pivotal characteristics in maintaining healthy immune responses.

Keywords: Immunity, Immune response, Nutrition, Antioxidants, Phytochemicals, COVID-19

INTRODUCTION

A strong immune system is not a dream anymore. It is mandatory to maintain good nutritional status to fight against pandemic of COVID-19 and other viruses [1]. When humans get older, the severity and risk of infections differ due to immune competence according to how the immune system matures, develops and declines. There are various factors which influence the immune system and its competence, including nutrition [2]. Nutritional status of individual is affected by factors like sex, age, health status, medications and life style [1]. Since last decade studies have proved that our health and immunity depend on the quality of food, the amount we take and the characteristics of the nutritious elements and their interaction with the body's defensive cells, gene regulation and DNA. We can directly benefit from good nutrition and indirectly it all adds up to be useful with the normal defenses of the body. If nutrition is adequate, then our cellular stressors decrease and our body flourishes [3].

Each and every cell of the body has need for proper and sufficient nutrition, lack of which can lead to diseases at the cellular level, which can grow into a full-fledged syndrome. Our immune system is never dormant, cells undergo changes and microscopic requirements are needed for the health and safety of cells. But when the cell's immune system is activated, by means of an intra-cellular or plasmic intruder, then these cells need more than normal level of energy or increase in the basal energy expenditure during those periods, whether it may be a cold, cough, seasonal allergy, flu or beyond. Fever is another time when the basal energy expenditure is increased. Good nutrition is the essential requirement of our body in these times.

Cells can grow old beyond the respective age if someone is under the effects of certain toxins, it may be smoking, alcohol, illicit drugs or as simple as excessive sugars and salt. When cells are older than their biological age, the

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defenses of the cell get weaker and the person suffers with recurrent infections or growth of the tumors to early death or disability. Inadequate nutrition cannot initiate an anti-inflammatory response when required by our body. Positive immunological outcomes will not only maintain and regulate the functions of immune cells but will also permit them to initiate appropriate response against pathogens and avoid any chronic inflammation.

Exogenous sources like diet can fulfil the demands of immune system for the requirements of nutrients & energy but in case of inadequate dietary sources, body stores are used as endogenous sources. If diet is high in saturated fats and refined carbohydrates (sugars) (collectively called Western diet) globally, it contributes to the prevalence of type 2 diabetes and obesity, and could place these susceptible groups to high risks for severe COVID-19 pathology and mortality [4]. Effective immune system is linked to some dietary components & micronutrients examples Zinc & Vitamin A regularize cell division & are vital for proliferative response in the human Immune System. Arginine, an amino acid, helps in the production of nitric oxide which regulates immune and inflammatory cells like antigen-presenting cells, macrophages, neutrophils, natural killer cells, T lymphocytes and mast cells [5]. One of the well-recognized global public health problems is micronutrient deficiencies, and compromised nutritional status predisposes to certain infections [2].

DISCUSSION

Impact of under nutrition on Immunity

Immune functions are impaired by under nutrition resulting from famine/ shortage of food in developing countries or malnutrition due to hospitalization in developed countries subject 45% of children's mortality death is due to under nutrition, as it deteriorates immune function and enhances vulnerability for infectious diseases [6,7]. Protein energy malnutrition causing developmental delays & weight loss is the commonest cause of immunodeficiency leading to death due to infection as it affects the thymus & is responsible for lymphoid tissue atrophy [8].

Immunity and Antioxidants

Antioxidants are powerful tools in our hands. When we are stressed or as we grow older there is an increased accumulation of Reactive Oxygen Species (ROS) which enhances inflammation & oxidative stress in the human body. The excess of proinflammatory molecules & oxygen radicals, severely impairs the immune system. Antioxidants help us in improving the performance of the immune system by blocking the negative effects of ROS. These antioxidants include Vitamin E & Vitamin C, lutein, lycopene, zeaxanthin, selenium and carotenoids (beta carotene) [9]. They are abundantly found in spices, vegetables, herbs, tea & fruits. Antioxidants help in the prevention of diseases like Cardiovascular diseases, diabetes & cancers [10].

Immunity and Vitamin A

Vitamin A, as retinol derived from food sources coming from animals & as carotenoids from animal food sources, plays a vital role in regulation and maintenance of the immune system, and has its function in reproduction, eyesight, pre & postnatal developments. In recent studies when healthy controls were compared with allergic patients, it was evident that there were reduced serum vitamin A levels in allergic patients. Symptoms of asthma in adults & allergic diseases in offspring's can be prevented by supplementation with vitamin A during pregnancy. As retinoids have their impact on Inflammatory signaling pathways, regulation of immune homeostasis is their key role [11]. Retinol is mainly found in liver (animal), fortified food and whole milk while carotenoids are found in plant foods like dark green, yellow & orange vegetables & fruits.

Vitamin C and Immunity

Prevention of tissue damage & for immune system regulation Vitamin C has its vital role. Severe deficiency of Vitamin C can lead to higher susceptibility to infections and impaired immunity. It also has a positive effect to shorten the symptoms of the common cold. Acute infections can be responsible for depletion of stored Vitamin C in the body due to increased metabolic requirements. The immune system is regulated, and tissue damage is prevented by Vitamin C [12].

Dietary Vitamin C is abundant in guava, orange, lemon, kiwi, papaya, mangoes, kale, capsicum, yellow, red or green pepper, tomatoes, strawberries, sweet potato, cantaloupe, broccoli and cauliflower.

Vitamin D and Immunity

Skin exposure to Sunlight Ultraviolet B (UVB) is the main source of Vitamin D and there are few sources of vitamin D that can be consumed as food like fatty fish, cod liver oil, egg yolk, beef liver, fortified food and cheese. Vitamin D receptor expresses antigen presenting cells, immune cells, B cells and T cells [13]. In human and animal models, lower levels of serum 25 hydroxy Vit D are associated with inflammatory, autoimmune & infectious conditions. Anti-inflammatory mediators in immune cells are regulated by vitamin D [14]. Supplementation of Vitamin D, A selenium and zinc may be beneficial for both treatment as well as prevention of viral infections [15]. Results of a study suggested that deficiency of selenium or vitamin D may lower the immune defenses against viral pandemics like COVID-19 and cause progression to severe disease [16].

Immunity and Vitamin E

It is revealed from human & animal studies that cell-mediated and humoral immunity is impaired by the deficiency of Vitamin E. Reduction of oxidative stress is the key immunoenhancing effect exerted by Vitamin E [17]. Vitamin E has a diverse role, it not only works as an

antioxidant but also inhibits protein Kinase C activity & interacts with transport of proteins & enzymes [18]. Dietary Sources of Vitamin E include seeds & nuts, like hazelnuts, peanuts, almonds, sunflower seeds, vegetable oils such as safflower, sunflower, corn, wheat germ and soybean oils.

Immunity and Zinc

Zinc is an important trace element and its deficiency can have detrimental effects on immune cells which can lead to inflammation & even death. Development of both adaptive and innate immune cells, requires trace element Zinc as an essential constituent [19]. Development of inflammatory diseases and increased susceptibility to infections is enhanced with both the deficiency and excess of Zinc [20]. Zinc possesses antiviral effects on humans. Metallothioneins which are the zinc binding proteins have antiviral roles. Studies have proved that both acute and chronic viral infections improved due to the appropriate therapeutic administration of Zinc [21]. Dietary sources for zinc include red meat, Oysters, shellfish and poultry as excellent sources. Chickpeas, legumes, baked beans, nuts (almonds & cashews) contain zinc too. Milk products, eggs & whole grains are some of the other sources of zinc.

Immunity and Omega 3 Fatty Acids

Since last 30 years effect of Omega 3 fatty acids on immune system has been studied. Activation of cells in both adaptive & innate immune system is exerted by these polyunsaturated fatty acids [22]. ALA the α-linolenic acid is the type of omega 3 PUFA which is abundantly found in seeds & nuts whereas DHA (docosahexaenoic acid) and EPA (eicosapentaenoic acid) are mainly found in fish oils [23]. Foods rich in Omega-3 fatty acids are halibut, salmon, sardines, trout, albacore, herring, shrimp, cod, spinach, flaxseed, walnut & canola oil.

Phytochemical and Immunity

The color and flavor of fruits and vegetables is due to compounds called photochemical. Photo chemicals derived from various parts of plant comprises of immense anti-inflammatory, anti-oxidant, neuro- protective, anti-cancerous and cardio protective properties. Turmeric is considered a medicinal plant as it contains photo chemicals. It has been observed in parts of the world where turmeric or its ingredient (curcuminoids) when consumed even in low doses can prevent or even treat inflammatory diseases of joints, brain, eyes and gut, in humans as well as animals [24]. Onions are rich in dietary flavonoids and have 3 diverse and valuable phytochemicals in appropriate proportion including organosulfur, flavonoids, & fructan compounds. Studies showed that intake of Welsh Onion Green Leaf Extract (GLE) helps to regulate body immunity [25].

CONCLUSION

It can be concluded that the top priority for healthy living is healthy eating and in order to reduce susceptibility to infectious diseases and long-term complications from coronavirus infections, individuals should be habitual of healthy eating habits [4]. We can conclude that balanced nutrition which includes fruits & vegetables group, meat, fish & poultry group, milk & its products, cereals, legumes and grains all in appropriate amounts are required for the maintenance of a good immune system and longevity. Micronutrients like Vitamin A, C, D, E and Zinc are positive mediators which boost our immune system. The role of other antioxidants, photochemical and Omega 3 fatty acids also regulate and maintain adaptive and innate immunity.

All of the above are found in nature. Avoid processed food. Stay close to nature. Eat what looks like real food instead of boxed products where you have to read the ingredients. Eat your food as medicine (prevention) or you might end up eating medicines as your food.

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DISCLAIMER

The article or part of the article has not been published in any other journal.

CONFLICT OF INTEREST

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