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The Effect of Nutrition in Promoting the Immune System Against Diseases: Covid-19 as a Case

Riyadh Abdulmajid.S. Thabit [1, *], Sarah A. Alselwi[1], Suha A. Alhag[1], Hebah H. M. Almothana[1], Fardous G. Alsoufi[1], Shaima'a S. Al-arieqy[1], Sarah S. Alabsi[1], Aisha S. S. Dhaiban[2]

[1]Department of Therapeutic Nutrition, Faculty of Medicine and Health Sciences, AL-Saeed University, Taiz, Yemen.
[2] Department of Clinical Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Aden University, Yemen.

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Abstract: A new virus strain spreading from person to person is the novel coronavirus (COVID-19). Before you get sick, the diet's role in fostering a healthy immune system starts. Promoting a healthy immune system by eating a regular high-quality diet would make it quicker and easier to fend off disease. Immune function plays an important role in micronutrients and antioxidants, such as iron, zinc, vitamin D, vitamins A, E and C, and phytochemicals, including beta-carotene. A well-working immune system against diseases as COVID 19.

Keywords: Immune system, Immune function, COVID 19, Nutrition, Nutrient.

1. Introduction

The immune system protects the host from infectious agents (bacteria, viruses, fungi, parasites) that reside in the environment and from other harmful insults. The immune system is a network of cells, tissues and organs working together to protect the body from "foreign" attackers' attacks. Since the human body provides many microbes with an ideal climate, they attempt to break in. It is the duty of the immune system to hold them out or, failing that, search them out and kill them (National Institute of Allergy and Infectious Diseases National Cancer Institute, 2003)

Coronaviruses are a family of viruses ranging from common cold to MERS coronavirus, which is the coronavirus of Middle East Respiratory Syndrome and SARs, the coronavirus of Extreme Acute Respiratory Syndrome. It is a genus of the family Coronaviridae, enveloped by viruses with a broad genome of plus-strand RNA. In size, capped and polyadenylated, the genomic RNA is 27–32 kb. There have been three serologically distinct groups of coronaviruses identified (Holmes& Lai, 2003 and Guy *et al*, 2000). Three human coronaviruses have been studied in detail. HCoV-229E and HCoV-OC43 were identified in the mid-1960s, and are known to cause the common cold (Bradburne *et al*,1967; Peiris et *al*,2003 and Drosten *et al*, 2003).

Adequate and appropriate nutrition is required for all cells to function optimally and this includes the cells in the immune system (Caroline E *et al*,2019; Chandra, 2002).

2. Immune system

The immune system, which protects living organisms from harmful substances, is a common name for structures within our bodies. There are several components of self-defense in the human body. The external creatine coating on the skin is one of the simplest of these. Biochemical body units are another aspect (Kursat Karacabey and Nurfer Ozdemir, 2012). Mechanisms of host resistance can be split into two main levels: nonspecific and specific antigen (Figure 1 and Figure 2). Figure 1 A clear view of host defenses as a defensive umbrella consisting of physical harriers (skin and mucous membranes (complement. interferon. lysozyme. and phagocytes). And antigen-specific processes (antibodies of isotypes of live immunoglohulin and inimunity mediated by cells) (Chandra RK, 1992). The figure 2 The immune system is a bridge of life. During fetal and early postnatal life. it undergoes development and maturation. Sex, adaptation. exercise. immunization. and nutrition are important determinants. Stress and diseases such as cancer can impair further immunity and end in a fatal outcome (Chandra RK, 1992)

These mechanisms are adaptive and acquired in that they are specific reactions induced by prior exposure to the microorganism on its antigenic determinants (Ranjit Kumar Chandra, 1997).

Figure 1. A simple view of host defenses as a protective umbrella (Chandra RK, 1992)

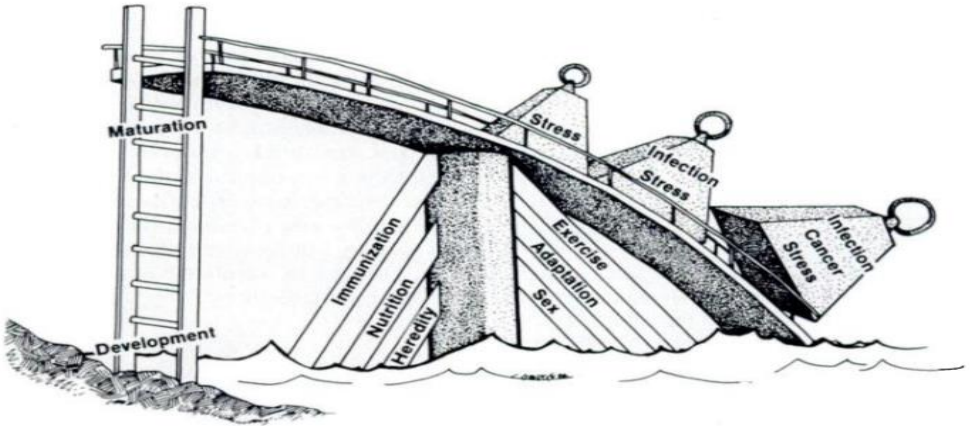


Figure 2. The inimune system is a bridge of life. (Chandra RK, 1992)

The first line of defence against infectious agents is innate immunity. It is present before exposure to pathogens, and such exposures do not improve its behavior. Innate immunity is concerned with preventing infectious agents from entering the body, and with their rapid removal if they do enter.

The precise identification of molecules (antigens) on an invading pathogen requires acquired immunity, which identifies it as being foreign to the host. The detection of antigens is by antibodies. (Philip C et *al*, 2002).

3. Effects of Nutrients on the immune system

Deficient intake of macro-nutrient elements (fat, carbohydrate, protein) or deficiency of certain particular micronutrient elements are the dietary factors that cause damage to immunity functions (vitamin, mineral, water). Balanced diet increases resistance to infections, especially in terms of adequate vitamin, mineral and protein intake. Research shows that healthy diet subsidizes the immune system and Cary puts vital emphasis on the system (Chandra RK ,1997), (Chandra RK, 2003; Chandra, 2002; Greiner T,2011. The dietary factors that cause malfunction in immune system could be insufficient intake of energy and macronutrients (CHO, protein, fats) or deficiency of specific micronutrients (Basoglu S, Turnagol H, 2004).

For example, antioxidant nutrients play a key role in maintaining the balance of antioxidants/oxidants in immune cells and in protecting them from oxidative stress and preserving their proper function (Victor & de la Fuente, 2002). Back to the diet, the addition of the deficient nutrient will restore immune function and infection resistance. Excessive quantities of certain nutrients, however often impair immune function (Calder and Kew,2002; De Pablo & Alvarez de Cienfuegos, 2000).

4. The role of healthy food in improving the immune system

Perhaps one of the most important elements that sustains our immune system is a healthy, balanced diet Which contains all the nutrients of proteins, carbohydrates, fats and vitamins / minerals in balanced proportions with the following healthy eating habits such as eating too much vegetables And fresh fruits of all kinds because they contain many useful nutrients, and nuts Because it contains (proteins, magnesium) and fish because it contains (zinc) that works to produce Blood cells that fight infection, yogurt, fiber, mushrooms, garlic, olive oil including Contains antioxidants. (Munkyong, P *et al*, 2012).

Many studies of the interaction between nutrient availability and immune function have been performed in animals and these have often compared the effects of diets containing insufficient, sufficient and, in some cases, excess amounts of an individual nutrient under study (Philip C *et al*, 2002).

The essential amino acids, essential fatty acid linoleic acid, vitamin A, folic acid, vita-min B6, vitamin B12, vitamin C, vitamin E, Zn, Cu, Fe and Se are nutrients that have been shown to be important for the immune system to function effectively (in either animal or human studies) (Calder & Jackson, 2000). Deficiencies in one or more of these nutrients can impair virtually all types of immunity and the deficient animal or person becomes more vulnerable to infections. (Scrimshaw & San Giovanni, 1997; Calder & Jackson, 2000).

The important to avoid eating hydrogenated oils And the saturated fats and starches in large proportions especially the roasted potatoes and chips High-fat meats, Fast Foods and fast food And ready-made pancakes and similar cakes, tart and oriental sweets where they are rich in fat saturated, roasted foods, reduced intake of sugars and drinking carbonated water and juices where It was found to slow down the activity of a white blood thinner in attacking microbes and reducing the efficiency of The immune system of the elderly, reducing the intake of refined foods (whitesugar, salt white,

white flour) and use whole flour instead of white flour, instead of salt His replacement is potassium salts (Calder & Jackson, 2000).

Also, to refrain from smoking because it produces free incisions that break down. Immune cells in the body and cigarette smoke contains thousands of chemicals and most of them The effect of the t is nicotine where it affects the central nervous system, increased adrenaline rice, and increased Blood pressure, heart rate, speed of metabolism, affects the immune system Which is the nitrogen dioxide ozen because cigarette smoke contains a high turkey from a compound Which in turn accelerates the emergence of aging DNA antioxidant vitamins and causes the smashing of And weakening immunity (Scrimshaw & SanGiovanni, 1997)

5. The role of drinking water in improving the immune system

Any of these important minerals can be found in drinking water sources naturally or by deliberate or accidental addition. The supply of water is highly variable in its mineral content and although some contribute large quantities of such minerals either due to natural conditions e.g., Ca, Mg, Se, F, Zn), deliberate additions (F), or piping leaching (Cu), most have lower amounts of important nutritional minerals. Because of the fact that many people drink mineral water (WHO.2005; Youssef, 2004)

6. The role of probiotics in improving the immune system

Probiotics are live microorganisms' as per FAO/WHO, which provide health benefits to the host when administered in sufficient amounts. Recent developments in probiotic research, however may lead to changes in the actual concept of a probiotic. In various patho-logical conditions, multiple probiotic strains exert different immunomodulatory activities, such as allergic disease, colitis, rheumatoid arthritis, colorectal cancer, depression, anxiety (Ganesh BP, Versalovic J, 2015 and Kang H-J, 2015). Probiotics are defined as live microorganisms that, when administered in adequate amounts, confer a health benefit on the host, including the gastrointestinal tract. (R. Herich, M. Levkut, 2002). There is a type of bacteria that lives in the intestines, especially the colon, which is a bacterium that does not cause disease but it has a protective characteristic against the mother and the number of hundred trillion bacterial cells, and this number is ten times the cells of the body and the system because these bacteria have many benefits, including resistance. One of its benefits is probiotics, which are called friendly bacteria or probiotics (Cebra *et al*., 1999).

Resistance to microbes that invade the digestive system and because microbial enemies lead to Disorders in this system such as colitis and abdominal pain as well as causing injury with a fever. These friendly bacteria are a plant to produce many of the vitamins necessary for the body Folic acid, as well as helping to raise, vitamin K and some of the B vitamins, such as vitamins, the level of female hormone (estrogen) in women, strengthening the effect of the pill and activating Gastrointestinal immunity against pathogenic microbes is also beneficial in the body's resistance For cancer especially colon cancer and from the enhanced probiotic bacteria of cellular immunity in the elderly, It is a friendly bacterium found in fermented dairy products and plays an important dotis HN019 Improving digestive immunity against maternal-causing microbes and prevention of infection Colon cancer.

America and some countries in Europe and Asia have produced a pharmaceutical drug market Used as an alternative to friendly microbes that live in the intestines to compensate for the lack of friendly bacteria in the elderly (Arunachalam et al., 2000)

7. The role of dairy products in improving the immune system

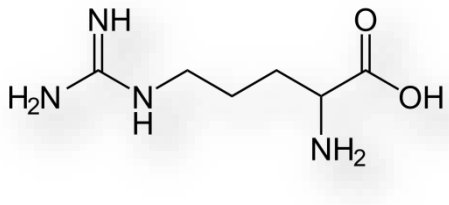
Play dairy products such as: fermented dairy and skimmed yogurt made from milk Unpasteurized, yogurt, and turkey cheese, which is a food rich in natural yeasts, An important vital in the fermentation of undigested plant fibers and converted into chemicals that seep into me, Blood flow helps boost the functioning of the immune system, and helps reduce cholesterol, Reduces the risk of heart disease and helps increase microbiology beneficial that reduces allergies and chances of developing malignant or reactive remand bowel ulcers Diarrhea and lowering high blood pressure, so should eat too much faty yogurt, Because it increases beneficial bacteria, especially in cases of illness or weakness or in convalescence after the procedures so that one or two cups of it are eaten at each meal (Youssef, 2000.;Verhasselt V, 2010 ;Lluis A *et al*, 2014

8. The role of Amino acids in improving the immune system

It has long been known that dietary protein or amino acid deficiency impairs immune function and increases human susceptibility to infectious diseases. In plasma, protein malnutrition decreases the concentrations of most amino acids. Studies have shown that amino acids play an important role in immune responses by regulating: (1) activation of T lymphocytes, B lymphocytes, natural killer cells and macrophages; (2) cellular redox status, gene expression and proliferation of lymphocytes; and (3) the production of antibodies, cytokines and other cytotoxic substances. Increasing evi-dence shows that dietary supplementation of specific amino acids to animals and humans with malnutrition and infectious disease enhances the immune status, thereby reducing morbidity and mortality (Peng Li, *et al.* 2007).

8.1. Arginine:

Arginine is a basic amino acid needed for the natural growth process, and when the drug preparations were used, researchers found that it protects the thymus gland from relapsing changes and helps to increase the rate of white cell proliferation.



Also, the food Arginine helps to increase the rate of proliferation of lymphocytes in the blood and thus it helps to solve one of the problems suffered by the elderly and it also protects against the enlargement of the themus gland and it is well known that aging leads to several changes in the immune system, which makes them the most groups at risk of infectious diseases, when adding Arginine at 2% of the meal, researchers found that it protects against some of these changes.

In a study he conducted (Brandon and bobbi , 2000) on experimental animals with the aim of recognizing the effect of Arginine on the immune reaction, the addition of Arginine has been found to help increase immune reaction and protect against immune changes that accompany aging.

The addition of Arginine (semi-essential amino acid) to the diet of patients has been shown to have positive effects on the immune condition in patients with its weakness, it also helps to speed

up wound healing, and maintains Nitrogen of the body reduces the periods of hospital stays of patients.

In one study, researchers found that the increase in the percentage of Arginine in plasma led to a decrease in the incidence of infection. And there are other studies that have shown that the combination of Arginine, omega-3 and ribonio click acid in a single mixture has improved immune function and speed of recovery after surgery. In a study conducted in Amsterdam, Netherlands (Marian *et al*, 2001), the researchers found that the administration of Arginine for cancer of the neck and head cancer before surgery led to improved immune function and increased the rate of production of cytokines as well as reduced the rate of infection and reduced the length of their stay in the hospital and also found that meals supported by Arginine prolong the life of patients after Surgical procedures. So, Arginine is one of the important amino acids of the immune system. This may be due to its role as a generator in the process of nitrogen synthesis in addition to the regulatory of many physiological processes, which include the regulation of the functioning of pharynx and killer cells, as well as the formation of the activation of lymphocytes. (Evoy, *et al*, 1998).

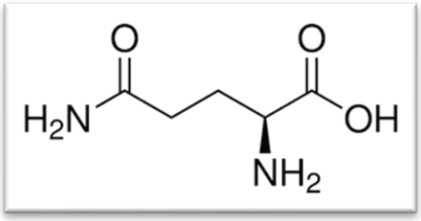
In the end, a reference study conducted in 2004 mentioned (Douglas, 2004), the administration of Arginine through the intestines has improved the immune function of normal people and some but not all patients, he said. But giving Arginine alone has proved to be of no use and no harm, and so far, there is no convincing evidence to support the administration of Arginine alone to treat some acute diseases and the possibility of some harm that should be given in critical cases only besides other drugs.

8.2. Alanine:

Alanine is a major substrate for the hepatic synthesis of glucose, a significant energy substrate for leucocytes (Newsholme , 1997), thereby influencing immune function. There is evidence that supplementation with 2mM-alanine to the culture medium prevented apoptosis, enhanced cell growth and augmented antibody production in B-lymphocyte hybridoma.

8.3. Glutamine:

Although Glutamine is considered one of the non-essential amino acids, recent studies have shown that this acid may become in the coming years of essential amino acid for its effective and important role in the body, especially in cases of infections, infections and various infections. It is now well known that in normal cases Glutamineis essential to cell proliferation and plays an essential role in the functions of immune cells (Newshlme,2001).



Glutamine acts as an energy source for the digestive tract, liver and immune cells. Glutamine lymphocytes are used at very high rates, and these rates are increased in cases of increased lymphocytes activity, for example in cases of reproduction and division. All this has led scientists

to believe that Glutamineplays a very important role in the functioning of these cells. Indeed, Glutamineis an essential substance for the proliferation of lymphocytes in humans and animals.

Studies have also shown that the presence of a sufficient amount of Glutaminein the body increases the production of interleukin 2, interleukin 10 and interverone. The researchers have observed that the concentration of Glutaminein plasma decreases when exposed to burns and diseases after surgery and after exercise and all these cases,the risk of infection and diseases is increased. Scientists believe this is due to a lack of Glutamine, which helps immunity, especially lymphocytes, to function (newsholme and calder 1997). Based on all of the above, Glutamine acid has become the focus of many studies in the field of immunology.

8.4. Glutamineadditives and immune functions:

Glutaminecan improve cell function after infection and help keep these cells alive, so Glutamine tablets are important and necessary in the pharmacological field. The question that arises strongly is whether Glutamine from food sources strengthens the functions of immune cells or not in answer to this question he observed (Yoo *et al*, 1997), "The proliferation of blood lymphocytes in animals with e. coli is morally higher when the animals fed a meal containing 40 grams of Glutamineper kilogram of body weight compared to a meal that does not have this amount". Moreover, he found (Li., *et al*, 1998),"Glutamineor annilGlutamine preserves the lymphocytes released from Bayer pieces and maintains the integrity of the intestinal membranes in cases of flu". And in a study (Peng Li, *et al*. 2007), The researchers studied the effect of eating different amounts of food Glutamineon the functions of lymphocytes in experiment animals and researchers found that "the level of Glutamine in the blood is greatly influenced by it's level in food as they found that the increase of Glutamine in the meal increases the rate of proliferation and cell activity T and supports cellular immune reaction".

9. The role of fatty acids in improving the immune system

It is known that fatty acids play diverse roles in immune cells. They are important for the synthesis of eicosanoids and similar mediators as a source of energy, as structural components of cell membranes, as signaling molecules and as precursors. The location and organization of fatty acids in separate cell pools has a direct impact on the behavior of a number of immune cell activation proteins, including those associated with T cell responses, presentation of antigens and fat cell activation. (Parveen and Philip, 2007).

Laboratory studies conducted on experimental animal showed that saturated fatty acids have little effect on the proliferation of lymphocytes, T-cells 1&2 (which produce cytokines) and killer cell activity.

9.1. Oleic Acid:

Laboratory and laboratory studies on experimental animals have shown that "eating sufficient amounts of this acid can inhibit the proliferation of lymphocytes, the production of interleukin 2 and the activity of killer cells". But I think this needs more studies because we know very well that olives are god-made in his dear book and olive oil is a very beneficial oil for health because of what it contains of this acid and when I researched and excavated i found that there is a study (Yagoob *et al*., 2000)"Who added 9 grams of olive oil to some people's meals for 12 weeks and found no adverse effect on cell proliferation, the production of various cytokines or the activity of killer cells".

In another study conducted by the same researcher in 1998(Yagoob *et al* ., 1998) "It was found that the increase in the percentage taken from the oleic acid from 11% to 18% of the total calories at the expense of saturated fat in some people's meals for two months did not reduce the cause of the killer cells or the rate of proliferation of lymphocytes.

9.2. Linoleic Acid:

Laboratory studies on experimental animals have shown that "adequate amounts of linoleic acid may partially inhibit lymphocytic proliferation, interleukin 2 production, killer cell activity and IGG and IGM antibody production" (Calder, 1995).

Accordingly, some believe that large amounts of this acid caused a defect in the reaction of cellular immunity and the production of antibodies. However, there are some studies that "have found that eating medium amounts of linoleic acid did not affect the proliferation of lymphocytes or the activity of deadly cells" (Jeffery *et al*., 1997).

Interestingly, some studies conducted on humans in which volunteers are given a low-fat meal (25% of calories) rich in linoleic acid (12.9% of calories) and others low in linoleic (3.5% of calories) found no differences in lymphocytes or the production of antibodies, moreover. Another study in which the researchers "gave 9 grams of sunflower oil (rich in linoleic acid) daily for 12 weeks and there were no negative changes in immune function" (Calder *et al*., 2002).

9.3. Omega-3 Acids:

First the all, we should identify EcosapanoicAcid, an Omega-3 Fatty Acid and DocosahexaenoicAcid . It has been shown that "human intake of large amounts of fish oils has led to an increase in these acids in the membranes of cells that cause inflammation such as monocytogenes, large pharynx, nitrophilia and lymphocytes" (Healy *et al* .2000). These acids are also known to inhibit the production of cytokines and immune cells and reduce the ability of monocytogenes to display the anti-inflammatory, antagonisms to specialized cells for examination and handling. Many unsaturated fatty acids (Omega-6 and omega-3), which are found in mother's milk and some children's mixtures in high proportions, are involved in regulating inflammatory reaction. However, various studies have shown that "the immune reaction can be altered by food, especially by omega-3" (Terada *et al*. 2001). These changes include changes in the production of immune media and the proliferation of lymphocytes. The results of laboratory studies and studies conducted on experimental animals have shown that "the proliferation of lymphocytes decreases the more omega-3 in food" (Terada *et al*.2001). A few studies have shown that "eating medium amounts of many unsaturated fatty acids does not inhibit immunity but may increase it, for example, docosahexaenoic acid increases the proportion of memory cells and T cells in infants" .

On the other hand, the researchers noted that "the multiplication of monocytogenes decreases when feeding experimental animals on omega-3" (Sanderson *et al* .1997).It also hinders the passage of monolithic cells and lymphocytes between different parts of the body(Hughes and Pinder , 2000).

Many studies have shown that "the intake of Omega-3 reduces the secretion of certain cytokines such as interleukin 1&2 as it affects the production of prostaglandins, especially prostaglandin 2, and these negative effects of omega-3 on immune function have encouraged scientists to use it in the treatment of certain diseases in which infections occur, such as inflammatory bowel diseases, in which the immune reaction should be reduced to reduce infections and accompanying symptoms".

There are studies that confirmed that "omega-3 helps in the immune functions of the intestines and this information is considered a fertile and important field in the field of scientific research, and called on researchers to study the relationship between eating food Rich in omega-3 and gut diseases" (Miura *et al* ., 1998).

When antigen is present in the body is connected to it cells that occur a process of reproduction and increase in number and thus increase the resistance of the body and can eliminate antigen quickly, and without that process of reproduction causes a defect in the immune process. In a study conducted on healthy elderly people (Thies *et al*., 2001) In the UNITED Kingdom, researchers found that "gamma-linoleic acid (GLA) and fish oil (especially EPA) led to a moral decrease in the rate of cell reproduction of the immune reaction and estimated the decrease rate by 65%"and the researchers also found that this process returned to its normal rate after four a I'm going to sell to stop eating these acids. Therefore, researchers recommend that you do not eat fish more than once to twice a week. This was also confirmed by animal studies that showed that "the intake of experimental animals for large amounts of fish oil rich in long-chain omega-3 acids lead to a decrease in the rate of reproduction of lymphocytes in the spleen". In a study conducted in the United Kingdom (Samantha *et al*., 2004) the researchers compared the effect of taking olive oil, icuosabentoic acid (EPA) and doxahexaenoic reduced the activity of T cells, while ikusabentoic acid had no negative effect on immune functions such as pharyngeal process and cytokine production.

We believe that the results of his study (Thies *et al*., 2001) more accurate because it lasted for 12 weeks and the other difference is that the first study was conducted on the elderly while the second was conducted on adults.

Another study found that "eating 18 grams/day of fish oil (equivalent to 5 grams of long-chain omega-3 acid) inhibited many signs of specialized and non-specialist immune reaction.

For example, one study found that "taking 3 grams per day of omega-3 led to a reduction in some B-and T cell functions and most of these changes associated with the administration of these acids is the low rate of proliferation of lymphocytes and the occurrence of imbalance in the synthesis of interleukin 2 and reduce the production of cytokines Associated with infections such as anti-tumor factor such as anti-tumor and anti-tumor 1beta". And recently scientists have noticed (Anderson and Fritsche ,2002) one of the benefits of omega-3 will help you resist the malaria microbes and resist parasites. However, there is a serious lack of studies that are concerned with infectious diseases and omega-3 intake. The next few years may yield useful research in this field.

In general, a diet rich in omega - 3 tends to inhibit the immune reaction, while a diet rich in omega - 6 tends to strengthen the immune reaction, which leads to inflammation. The ratio of omega-3 to omega-6 in the meal may be more important than the number of fatty acids in the meal. This percentage has changed a lot in recent decades because vegetable oils rich in omega-6 have replaced many other fats in the diets of most people in Western countries.

10. The role of carbohydrate in improving the immune system

There are few studies that have been interested in identifying the effect of carbohydrates on immune function, especially the intestinal immune system. Most of them were focused on fiber, and almost all of these studies have found an interaction between them and the microbes naturally present in the intestines.

The effect of fiber on intestinal immunity has been discovered by researchers who conducted studies on experimental animals and found that they help to repair the imbalance that occurs in the immune system of the gastrointestinal tract, fiber also protects lymphocytes (Xu *et al.*, 1998).

Other studies have found that increased intake of non-digestible fermented sugars increases the secretion of antibody IgA (Koudoh *et al*., 1999), while increased intake of non-digestible fermented sugars has the opposite effect (Manhart& Roth, 2001). Oligosaccharides may be beneficial for immunity especially in the intestines. This is because they are probiotics and thus help microbes to support and strengthen the intestines. Recent studies suggest the sugars in breast milk may improve the baby's immune system directly (Klein *et al*., 2000). Other studies have been conducted on Raffinose sugar, which is not digestible sugar and is found in plant foods such as: beets, sugar cane, cabbage, potatoes, grapes, wheat, barley, corn and many pulses, so that studies found that giving him to healthy increased the proportion of Bifidu bacteria in the stool and reduce the toxic and pathogenic bacteria. This is because of probiotics, and some researches have recently discovered that it improves the condition of children with skin infections, and researchers believe that this effect may be due to the Raffinose reduces the production of the antibody responsible for allergies IgE by affecting T cells.

11. The role of vitamins and minerals in improving the immune system

11.1. Vitamin A:

Children's infectious diseases were once a global threat (Rytter et al.,2014). A close correlation between micronutrient deficiency (especially Vit A and infectious diseases spread through the respiratory and digestive systems in children has been suggested by recent research (Qi et al., 2016). Meanwhile, as a result of infection-induced anorexia and reduced absorption of Vit A from the intestine, many infections result in a decrease in systemic Vit A levels (Sivakumar & Reddy, 2016).

Table 1. The therapeutic effect of Vit. A on several infantile infectious diseases

Disease	Role of vitamin A	Method setting	Reference
Measles	Reduce mortality	Meta-analysis	(Yang et al.,2005)
Measles	Reduce morbidity and mortality	Systematic review and meta-analysis	(Mayo-Wilson et al., 2011)
Measles	Reduce mortality	Meta-analysis	(Sudfeld et al., 2010)

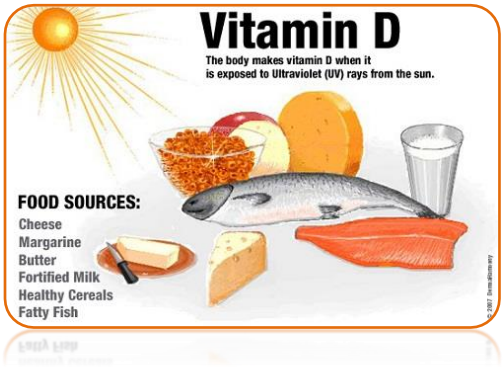
Measles	Reduce morbidity	Randomized double-blind controlled trial	(Bhandari et al., 1994)
Acute pneumonia	Promoting the production of specific antibodies	Randomized controlled trial	(Cui et al., 2000)
Acute pneumonia	Relieving clinical symptoms and signs	Meta-analysis	(Nan et al., 2018)
Infantile diarrhea	Reduce morbidity and mortality	Systematic review and meta-analysis	(Mayo-Wilson et al., 2011)
Infantile diarrhea	Promote the production of IgA in the intestinal tract and enhance the mucosal immune function	Randomized controlled trial	(Nikawa et al., 1999)
Infantile diarrhea	Reduce morbidity	Randomized double-blind controlled trial	(Bhandari et al., 1994)
Enteric infection	Reduce morbidity and mortality	Randomized controlled trial	(McDaniel et al., 2015)
Malaria	Reduce morbidity	Randomized double-blind controlled trial	(Elom et al., 2014)
Malaria	Reduce morbidity	Randomized controlled trial	(Owusu-Agyei et al., 2013)
Malaria	Reduce morbidity	Randomized double-blind controlled trial	(Zeba et al., 2008)
Hand foot and mouth disease	Promote production of immunoglobulin and enhance antiviral function	Cross-sectional observation and study	(Chen et al., 2012)

11.2. Carotens

Carotenes are antioxidants that affect the body's immune function. Studies have shown that "increased intake and high blood levels have been linked to increased resistance to infectious diseases and respiratory diseases". Recent research confirms that there is an inverse of cancer, no wonder we know that (Adrianne, 2004). Numerous studies conducted in the last decade of the twentieth century confirmed that beta-carotene has an effective role in the immune system. Studies conducted on healthy adults confirmed that "taking beta-carotene resulted in an estimated 30% increase in helper T cells". Other studies have shown that beta-carotene has helped to produce toxic T cells". (Okai & Higashi, 1996)

11.3. Vitamin D:

The role of vitamin D and its metabolites in the immune system, autoimmunity and susceptibility of the host to infection are assessed in a number of ways (Hewison, 2012). Vitamin D refers to the active form of vitamin D in this article (1,25-dihydroxy vitamin D3). The cytosolic vitamin D receptor is expressed by many immune cells and some can synthesize vitamin D's active form from its precursor (Hewison et al., 2003).



Indeed, vitamin D can induce macrophages to synthesise anti-microbial peptides (Liu & Modlin, 2008; Liu *et al.*, 2006)

;Sabetta et al., 2010;Urashima et al., 2010) . and of antibodies by B-cells, highlighting the paradoxical nature of its effects. Effects on Th2-type responses are not clear (Boonstra et al., 2001) and there may be an increase in numbers of regulatory T-cells (Barrat et al., 2002).

11.4. Vitamin E:

The major lipid-soluble antioxidant in the body is vitamin E, which is required to protect membrane lipids from peroxidation. Immunosuppressive radicals and lipid peroxidation are free radicals and vitamin E should therefore act to maintain or even improve the immune response. The role of vitamin E in the immune system and the susceptibility of the host to infection are reviewed in several ways (Wu & Meydani, 2008).

In laboratory animals, vitamin E deficiency decreases lymphocyte proliferation, natural killer cell activity, specific antibody production following vaccination and phagocytosis by neutrophils (Wu & Meydani, 2008; Medyani & Beharka, 1990).; Wu & Medyani, 2008; Pallast *et al.*, 1999).

Although some studies report that "vitamin E decreases risk of upper respiratory tract infections in the elderly" (Meydani *et al.*, 2004), other studies did not see an effect on the incidence, duration or severity of respiratory infections in elderly populations (Graat *et al.*, 2002).

11.5. Vitamin C:

The marked susceptibility to infections, especially of the respiratory tract, is a major sign of vitamin C deficiency scurvy disease, with pneumonia being one of the most common complications of scurvy and a major cause of death (Hemila, 2017). Patients with acute respiratory infections such as pulmonary tuberculosis and pneumonia have decreased plasma concentrations of vitamin C compared with control subjects (Bakaev & Duntau, 2004).

Table 2. Role of vitamin C in immune defense

Immune system	Function of vitamin C	Reference
Epithelial barriers	Enhances collagen synthesis and stabilization.	(Davidson et al., 1997).
	Protects against ROS-induced damage.	(Lin et al., 2003).
	Enhances keratinocyte differentiation and lipid synthesis.	(Kim et al., 2015).
	Enhances fibroblast proliferation and migration.	(Mohammed et al., 2013).
	Shortens time wound healing in patient .	(Desneves et al., 2006;.
Phagocytes (neutrophils , macrophages)	Acts as an antioxidant / electron donor.	(Oberritter et al., 1986).
	Enhances motility / chemotaxis.	(Goldschmidt, 1991).
	Enhances phagocytosis and ROS generation.	(Sharma et al., 2004).
	Enhances microbial killing.	(Goldschmidt,1991).
	Facilitates apoptosis and clearance.	(Fisher et al., 2012).
	Decrease necrosis / NETosis.	(Mohammed et al., 2013).
B- and T-lymphocytes	Enhances differentiation and proliferation.	(Huijskens et al.,2014).
	Enhances antibody levels.	(Tanaka et al., 1994).
Inflammatory mediators	Modulates cytokine production.	(Canali et al., 2014).
	Decrease histamine levels.	(Hagel et al., 2013).

11.6. Zinc:

Zn is important for the synthesis of DNA, for cell growth and differentiation, and for antioxidant defense, all of which are important for the function of immune cells. It is also for many enzymes, a cofactor. The role of Zn in the immune system and host susceptibility to infection are assessed in a number of ways (Calder & Jackson, 2000). Zn deficiency has a significant effect on the bone marrow, reducing the number of immune cell precursors (Fraker & King, 1993).

There are also marked effects of Zn deficiency on acquired immunity, with decreases in the circulating number and function of T-cells and an imbalance to favour Th2 cells (Prasad, 2000).

In patients with Zn deficiency related to sickle-cell disease, natural killer cell activity is decreased, but Zn supplementation returns this to normal (Tapazoglou *et al.*, 1985; Fischer & Black, 2004; Calder & Jackson, 2000; Prasad.2000)

11.7.Selenium:

Se is a cofactor for a number of enzymes including some involved in antioxidant defences such as glutathione peroxidase. Therefore, Se may protect against the immunosuppressive effects of oxidative stress, thus acting to enhance immune function.

There are a number of reviews of the role of Se in the immune system and host susceptibility to infection (Beck *et al.*, 2004). Se deficiency in laboratory animals affects both innate and acquired immunity and increases susceptibility to infections.

Lower Se concentrations in human subjects have also been linked with increased virulence (Wang *et al.*, 2009), diminished natural killer cell activity (Wang *et al*., 2009) and increased mycobacterial disease (Shor-Posner *et al*., 2002). Se supplementation has been shown to improve various aspects of immune function in human subjects (Roy *et al*., 1994), including in the elderly (Roy *et al*., 1995). Se supplementation in Western adults with low Se status improved some aspects of their immune response to a poliovirus vaccine (Broome *et al*., 2004).

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